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TROPICAL AGRICULTURIST

AGRICULTURAL JOURNAL OF CEYLON

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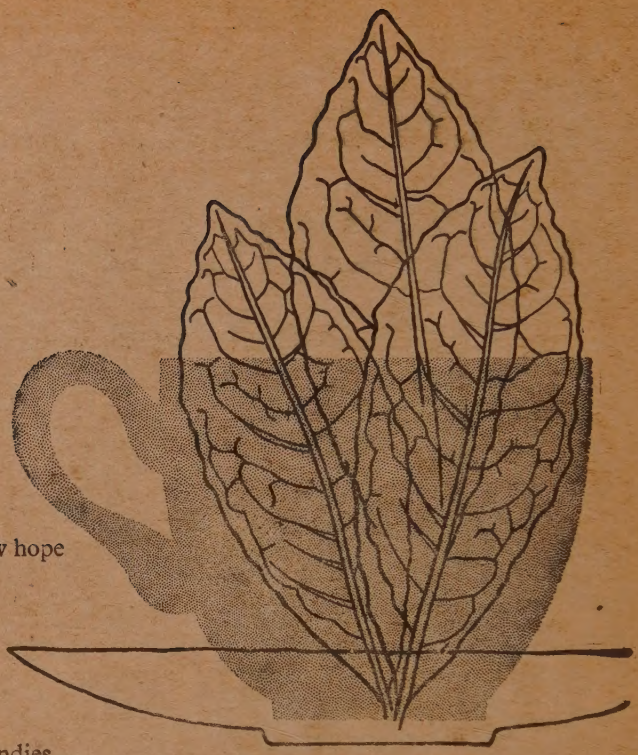

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EDITORIAL

The "Tropical Agriculturist"

THE *Tropical Agriculturist*, the oldest journal in the world devoted to tropical agriculture, was founded in 1881 and now celebrates its 75th anniversary with the 112th volume. The first editors were A. M. & J. Ferguson who compiled this 'monthly record of information for planters of tea, coffee, cacao, cinchona, sugar, cotton, tobacco, spices, rubber and rice' largely from reprints from the 'Ceylon Observer' of which they were the publishers in the words of the editors, 'the new journal endeavoured to embody in its pages the latest results of practical experience and scientific teaching in all that concerns tropical agriculture so that the periodical would not only be indispensable to the planter, but of service to business men and capitalists, never forgetting that agriculture touches upon every department of human knowledge, besides being the basis of personal and communal wealth'.

The early volumes teemed with extracts from foreign periodicals, news items of local interest, voluminous correspondence with contemporary planters, produce sales lists, &c., and covered about a thousand pages per volume. All this information was comprehensively and assiduously indexed.

In 1894, John Ferguson took over the editorship single-handed and continued in this capacity until 1905 when, with the formation of the Ceylon Agricultural Society of which he was the foster-father, he handed it over to Dr. J. C. Willis, Director of the Royal Botanic Gardens, Peradeniya. The journal was published under the title of *The Tropical Agriculturist and Magazine of the Ceylon Agricultural Society*. Thus ended the personal connexion of John Ferguson with this highly-prized journal which he had edited for well nigh 25 years.

Dr. Willis' editorship saw a number of changes for the better. Two volumes were published annually and these comprised, among other features, a number of illustrated articles of local agricultural interest by the scientific staff of the Department of the Botanic Gardens. With the formation of the Central Board of Agriculture in 1905 its minutes found a place in the *Tropical Agriculturist*. This practice has continued to date.

In 1912 the editorship of the journal was vested in Mr. R. N. Lyne, the first Director of Agriculture of the Island. A year later the Ceylon Agricultural Society acquired the *Tropical Agriculturist* and the journal then became the magazine of the Society. F. A. Stockdale (later Sir Frank) succeeded Lyne in 1916 as editor and continued the features which had been introduced by his predecessors but included, in addition, the monthly meteorological reports and animal diseases returns. With the dissolution of the Ceylon Agricultural Society in 1921, the *Tropical Agriculturist* (T.A.)

became the Agricultural Journal of Ceylon, and has, to date, been published by the Department of Agriculture under the editorship of the Director of Agriculture.

Under the guidance of its successive editors, two of whom were non-technical men, the journal has undergone some changes, but its essential character as a vehicle for disseminating information of scientific and practical value to planters, estate agents, local agriculturists and stockmen on tropical crops and stock, particularly those of the Island, has remained unchanged until now. Before the establishment of the Research Institutes for tea, rubber and coconuts in the twenties of this century, articles relating to these crops regularly found a place in the *Tropical Agriculturist.* But with the publication of their own periodicals, attention was directed in its pages to other crops of economic importance and matters of general agricultural interest to the Island. Until recently, however, the minutes of the Board meetings of these Institutes were published in the T. A. so that its readers could be kept informed of developments in these major agricultural industries.

The *Tropical Agriculturist* started as a monthly journal and continued thus till 1942, when, during the Second World War, as a result of a shortage of paper and printing difficulties its publication quarterly became obligatory. Since then the journal has been issued quarterly, but unlike in the days when it was a monthly, its pages have been exclusively devoted to original articles and features of interest relating to Ceylon agriculture. Strangely enough the format of the journal had not undergone any material alteration until recently when, in view of new developments in the printing and publication world, it was considered desirable to bring the journal up-to-date. Chief among the new features which have been introduced are a new type and a double-columned page. All photographs and line drawings which had earlier been printed on art paper and bound in separately, now form part of the text. A new cover of plain and simple design, with the recently-approved crest of the Department of Agriculture at the bottom right-hand corner, has also been introduced. Otherwise, the essential features of the old journal have been preserved.

In respect of agricultural content, however, the journal faithfully reflected the spirit of the particular period, and emphasis was placed on any special feature of agricultural interest at the time, whether it related to any particular crop or crops, e.g., coffee or rubber, an agricultural practice or system, e.g., soil conservation, green manuring or vegetative propagation, or an aspect of crop or livestock development, e.g., manuring, disease control, soil research, &c. Although it makes no claim to be considered an essentially scientific agricultural journal, its pages contain numerous features of considerable scientific agricultural interest, and the journal itself has been and is widely sought after by agricultural scientists and others interested in tropical agricultural research. It is interesting to

record that the *Tropical Agriculturist* has at present a circulation of 1,200 copies, 400 of which go overseas to 66 countries. The journal is on the exchange list of 195 scientific and agricultural publications.

With the declaration of Sinhalese as the official language of the Island, the character and scope of the journal has been reviewed. It is proposed to publish the *Tropical Agriculturist* as the Departmental Journal of Agricultural Science, in English, and to issue the *Govikam Sangarawa*, which was intended to be the Sinhalese counterpart of the *Tropical Agriculturist* when it was started by the Ceylon Agricultural Society in 1905, as a monthly on the lines of the popular agricultural journal *Indian Farming*. The Tamil quarterly, the *Kamat Tholil Vellakam*, which was also started by the Agricultural Society in 1906, would be brought into line with these proposed changes.

But whatever may be the future of the journal, the *Tropical Agriculturist* will be cherished by all those in any way connected with tropical agriculture as having been the repository of practical and scientific information on a variety of topics of interest and value to administrators, planters, scientific agriculturists and cultivators alike. It can claim to a proud record of service in the past and will, no doubt, whatever be its metamorphosis, continue to render equally useful service to its numerous readers in all parts of the world in the future as well.

It is with deep regret that the Editor has to announce the death of Dr. C. Van Dillewijn on 20.4.56 in Venezuela. Dr. Dillewijn was in Ceylon a few years ago as Advisor to the Government on sugar cane cultivation and sugar production under an F.A.O. assignment. He was the author of the book "Botany of Sugar Cane".

Errata

Tropical Agriculturist, Vol. CXI, No. 3, 1955, p. 211—Author's name should read *L. A. S. Perera* and not *S. V. Perera.*

P. 217, second column, line 20—insert *parent* in place of *forest.*

ARTICLES

"Tropical Agriculturist" — Its Agricultural Content

H. T. P. SAMARASEKERA, Librarian, Department of Agriculture, Ceylon

IN THE seventy-five years of its existence, the *Tropical Agriculturist* chronicled the agricultural progress and setbacks which Ceylon has been through, in addition to recording the researches of the Royal Botanic Gardens, the Ceylon Agricultural Society, and the Department of Agriculture, which in turn controlled its destinies. Thumbing through the contents of its one hundred and twelve volumes, the reader finds the problems that confronted the agriculturists of any particular period nearly always found expression in its pages. We see the personalities of the past, some of them acknowledged authorities in their field, revealed to the world in their work, and the fruits of their labours recorded for posterity in the pages of the *Tropical Agriculturist.*

King Coffee was toppling from its throne, when the brothers Ferguson in 1881 had the courage to launch the first volume of the journal before a critical public and frantic planting fraternity. To popularize it, two thousand copies were issued gratis. It is a matter for conjecture whether the coffee crisis itself was not responsible for bringing within the compass of this single publication, the mass of newspaper articles, Company Reports, Agents' Despatches, and planters' opinions of the time. Ceylon's was mainly a plantation economy, so that while rubber, coffee, cinchona, cocoa, cinnamon and tea were copiously written on, village crops, such as vegetables, maize, the millets, tobacco and local fruits, were barely touched.

To the scientific worker, the articles of those early numbers bear a marked contrast to those of the present day. So often they comprised the rather vociferously expressed opinions of practising planters, which were seldom backed by properly laid out experiments. One writer even stated (Volume I, page 85) that, "agricultural experiments are most costly luxuries to indulge in", and much of the knowledge gained was the slow accumulation of experience acquired by the even more costly method of trial and error. Sales Catalogues, Market Price Lists, Company Reports, and frequent letters to the Editor filled those early volumes.

Perhaps the only works that are yet recognized as of scientific merit were, the renowned researches of Dr. Henry Trimen on the *Flora of Ceylon,* and M. Cochran's *Manual of Chemical Analysis* both of which had their origins in the *Tropical Agriculturist.* Trimen succeeded Thwaites as Director of the Royal Botanic Gardens in 1880, and was a facile and prolific writer who read no less than fifty Papers before the Royal Society, of which he was a Fellow.

Trimen was succeeded by Dr. J. C. Willis as Director in 1896. The earliest experiments on rubber tapping and cocoa canker were the work of Willis. The turn of the century saw tea largely replacing coffee as Ceylon's leading plantation crop, and this change is faithfully recorded in the *Tropical Agriculturist* by a dwindling interest in coffee and a marked enthusiasm for tea. At the same time, the other plantation crops were not neglected.

In 1901 Willis inaugurated the Experiment Station at Peradeniya, followed in 1903 by its dry zone counterpart at Maha Illuppallama. These developments the journal chronicles in detail, and the reports emanating from these experiment stations were regularly published, with their wealth of experimental data.

The Ceylon Agricultural Society was formed in 1905, and it purchased the *Tropical Agriculturist* from the Fergusons who had published it hitherto. The numerous reprints from the *Ceylon Observer*, also of the Ferguson brothers, no longer found a place in it, and with Volume XXIV, No. 8, the format startlingly metamorphosed into that of a regular scientific journal. Dr. Willis was behind this change for the better.

By now, Willis had assembled under him a brilliant team of research workers that would be the envy of any scientific institution in the world today :—Tom Petch as Mycologist ; M. K. Bamber, Agricultural Chemist ; E. E. Green, Entomologist ; H. F. Macmillan at the Royal Botanic Gardens ; Herbert Wright in charge of the Experiment Station ; G. W. Sturgess, Government Veterinary Surgeon ; as well as R. H. Lock, C. Drieberg, E. Elliot and J. F. Jowitt.

This team set about their task with such enthusiasm that the *Tropical Agriculturist* now entered on its " Golden Age ". Papers poured from their pens with such facility that Peradeniya became a household word throughout the scientific world. Willis wrote on Economic and Systematic Botany, Petch on Mycology and Plant Sanitation, Green on Insect Pests, Bamber on Fertilizers, Macmillan on Horticulture, Sturgess on Animal Husbandry and Disease Control, Herbert Wright on Rubber and Cocoa, Jardine on Coconut.

Illustrating those volumes were brilliant photographs by Macmillan and Willis. Many of their publications, which are standard works to this day, had their beginnings in the *Tropical Agriculturist* of the time. Consider, Willis' *Flowering Plants and Ferns of Ceylon*, Petch's *Diseases of the Tea Bush*, and *Diseases of the Rubber Tree*, Green's classic work on the *Coccidae of Ceylon*, *Macmillan's* great *Handbook of Tropical Planting and Gardening*.

The proceedings of the Ceylon Agricultural Society were most readably recorded by C. Drieberg, while sections were found by the appropriate authority on Fibres, Oils and Fats, Gums and Resins, Drugs and Medicinal Plants, Agricultural Education, and a painstaking Bibliography by Willis. He also reprinted a brilliant address he had delivered abroad, on " Recent Progress in Tropical Agriculture ". Macmillan dealt with Edible Products, A. P. Goonetillake sent a long series on Bee Keeping, while Sturgess continued to contribute many papers on the diseases of domestic animals. Dr. and Mrs. Willis jointly published their " Dictionary of

Terms Used in Agriculture and Botany", and Mrs. Willis single-handed got up the first Catalogue of the Departmental Library; R. H. Lock kept up the sustained interest in Rubber.

At this period there was considerable agitation among politicians and agriculturists alike, for the establishment in Ceylon of an Imperial College of Tropical Agriculture, a project which eventually materialized in Trinidad. Detailed memoranda and plans for the Institute are there for all to see, in the pages of the *Tropical Agriculturist.*

In 1912, Willis retired from Ceylon in a blaze of glory, a Fellow of the Royal Society and perhaps the leading tropical agriculturist of his time. Petch now began to dominate the *Tropical Agriculturist* with his papers. His versatility was amazing: no subject seemed to be outside his field: Diseases of Tea, Rubber, Coconut, Coffee, Cocoa, Cotton, Fruit, the Cereals, Rubber Bark Renewal, Rubber Tapping, Coconut Flowering, Tea Manuring, Cover Crops, and numerous notes on work in progress. Quite often he wrote anonymously; and he still had time to compile his *Bibliography of Agriculture and Botany as a Peradeniya Manual, a* standard work of reference to this day.

The first World War in 1914, very much like the second, brought with it, unusual problems. A food and rubber shortage, and interest in local food crops triggered Drieberg's work on Rice Fertilization, D. S. Corbett's experiments on Tomatoes, Macmillan's on Palmyrah and Papaya and Chelliah's on Chillies. A. Rutherford, a brilliant worker, wrote on Shot-Hole Borer, Tea and Citrus Mites, and the Rhinoceros Beetle, until his untimely death deprived Ceylon of one of its best men. Bamber got into his stride with a series of manuring trials on each of the major crops in turn, as well as work on Soil Bacteria, Potash and Lime Content of Soils.

With Willis' exist, R. N. Lyne became the first Director of Agriculture, as the Department had now been set up with its separate Divisions of Botany, Mycology, Entomology, Agricultural Chemistry, &c.; these divisions' reports were regularly incorporated in the *Tropical Agriculturist.* H. I. Van Buuren, a most versatile young worker, wrote extensively and with authority on anything from Anthrax to Chillies. A new subject, Co-operation, and Agricultural Credit, began to loom large when N. Wickremaratne appeared on the scene with his forceful articles that continued for nearly two decades.

1916, and the Stockdale era began. The Headquarters, Laboratories, Library and Staff Quarters of the Department of Agriculture were planned, and built on their present location according to his specifications. His arduour for work was no less than that of his predecessors. All agricultural research was co-ordinated by the Agricultural Experiments Committee, whose deliberations found a place in the *Tropical Agriculturist.*

Stockdale was fortunate is possessing a first class team of plant disease and pest control officers, led by Petch himself. There were J. C. Hutson and G. M. Henry working on the minor insect pests, N. K. Jardine and F. P. Jepson dealing with Shot-Hole Borer, C. H. Gadd specialising in tea diseases. Together they waged an onslaught on Tea Tortrix, the Paddy Fly, Fluted Scale, Brown Bast, The Coconut Caterpillar and Rhinoceros Beetle, Black Rot, and Bunchy Top. As a result, the

research of the Department was heavily weighted on the pathological side nevertheless it is a matter for congratulation, that Petch, on his retirement, was acknowledged to be the world's leading tropical mycologist.

As early as 1921, tractor trials were carried out by Stockdale. He also wrote extensively on Co-operation, Rubber Tapping and Grafting, Soil Erosion, Coconut Selection, Pineapples. A gap in the contents of the *Tropical Agriculturist* which thus far had been devoted almost entirely to plantation agriculture, was filled by W. Molegode's numerous contributions on the village crops of Ceylon, which he kept up throughout about thirty volumes of the journal.

Paddy began to assume greater importance, and F. Summers, Economic Botanist, conducted trials on Tillering, while his successor, R. O. Illiffe, continued selection work with pureline paddy. T. H. Holland published the results of his numerous trials at the Peradeniya Experiment Station on Tea Manuring, Fodder Grasses, Rubber Tapping, Tobacco and Soil Erosion.

The Royal Botanic Gardens celebrated its Centenary in 1922 with a special number of the *Tropical Agriculturist* got up mainly by the indefatigable Macmillan. As usual, he illustrated his work with splendid photographs. Minutes of the newly formed Central Board of Agriculture were henceforth embodied in the journal, and so were the proceedings of the District Agricultural Committees.

The death of Bamber in a motor accident was a cruel blow to the Department. Joachim, who succeeded him as Agricultural Chemist, initiated work on Green Manuring, and his findings were later incorporated in the Departmental publication, the *Manual of Green Manuring*. The Rubber and Tea Research Institutes were founded, and a new journal, the *Tea Quarterly*, was published to which were diverted the research papers on tea. The Rubber Research Scheme continued to use the *Tropical Agriculturist* as their medium until they got up their own journal.

A remarkable series of trials on paddy purelines and manuring was laid down by L. Lord, and continued over a number of years. Eden of the Tea Research Institute wrote ably on Modern Field Experiments, while R. K. S. Murray of the Rubber Research Scheme contributed liberally on his subject. In spite of the weight of his responsibilities as Director, Stockdale found time to write on a whole host of subjects : Rubber, Cocoa, Papaya, Coconuts.

Parsons and Crawford arrived in the early nineteen thirties to take over the respective fields of Horticulture and Veterinary Science, on which they contributed. A very popular feature was the series of well illustrated articles on Ceylon orchids by Alex Sylva. Soil Conservation assumed world-wide importance at the time, and work in Ceylon was carried out by Lester-Smith and Felsinger. Seldom did a number of the *Tropical Agriculturist* appear without an article by Molegode on village crops.

Joachim and his co-workers, Kandiah and Panditteseker now began their investigations on the soils of Ceylon, a hitherto unexplored field. Starting from fundamentals, they followed up in successive years with a detailed study of the various soil types, and the first soil map of Ceylon was drawn. Joachim also wrote up a series of studies on

paddy cultivation, cotton manurial trials, the analysis of foodstuffs and uniformity trials with coconuts.

W. R. C. Paul published his experiments on the dry zone cultivation of tomatoes, and followed up with his classic experiments on chillies. M. Park and M. Fernando (later M. F. Chandraratne) began their researches on the diseases of tobacco and village crops, and later published a monograph on the subject as a Peradeniya Manual.

The Department of Agriculture was fortunate in possessing a very talented line of artists and draughtsmen, beginning with H. and W. de Alwis, who illustrated Trimen's "Flora of Ceylon", followed by George de Alwis, and G. L. de Silva. E. E. Green himself delineated his sketches of the "Coccidae of Ceylon", while G. M. Henry's drawings of insect pests were of a very high order. The latter's best work appeared subsequently in his books on the *Birds of Ceylon.*

1939, and the Second World War was upon us, bringing with it problems that were once again reflected in the pages of the *Tropical Agriculturist.* Articles appeared on Ceylon's Food Supplies by J. C. Drieberg ; Rice by G. V. Wickremasekera ; Cowpea by M. Fernando ; Sorghum by De Mel ; Soy Bean Trials by Haigh ; and Balsa by Parsons. New developments, such as artificial insemination, were dealt with by Mahamooth. Rosayro and Holmes of the Forest Department made valuable contributions with their researches into the Wet Zone Forests and Montane Grasses of Ceylon.

Wartime imports of cattle resulted in outbreaks of rinderpest, and Mahamooth, who worked to combat it, published his findings. The vitamin content of Ceylon foods was analysed by Joachim and Charavanapavan, while the latter stimulated interest in the canning and bottling of local foods ; jaggery and food yeast. Richards dealt with the numerous horticultural crops, including cocoa ; and the botany of Cassava, an important wartime substitute food, was studied by M. Fernando, and its hydrocyanic acid content analysed by Joachim. The Coconut Research Scheme continud to use the *Tropical Agriculturist,* and M. L. M. Salgado published important work on Coconut Manuring.

Trace element work on the magnesium content of Ceylon soils was carried out by D. E. V. Koch, and later by S. Kandiah, while B. A. Baptist investigated the use of the new insecticides DDT and BHC against local pests. R. D. Kreltzsheim's papers on "Rain Clouds and Rain in Ceylon" were of fundamental importance, while useful articles appeared by C. R. Karunaratne on Agricultural Implements.

The arrival of D. Rhind as Director of Agriculture in 1947 saw a renewed interest in rice coinciding with the granting of Ceylon's Independence. Rhind was a specialist in rice, and published his findings in the *Tropical Agriculturist* and in foreign journals of repute. There appeared papers by M. F. Chandraratne on Photoperiodism in Rice, and Random Sampling of Paddy ; by D. V. Ariyanayagam on Pre-Sowing Treatment ; and by E. F. Abeyaratne on Unrecorded Paddy Varieties. Statistical studies on the systematic genetic improvement of Ceylon cattle in general, and the Sinhala breed in particular, were inaugurated by Mahadevan. Panditteseker

did original work on animal Nutrition and Foodstuffs.

Maclagan Gorrie, who was Soil Conservation Officer for all too short a period, displayed a remarkable capacity for work, and contributed liberally to scientific journals in many parts of the world as well as to the *Tropical Agriculturist*. Paul published a series of papers on Legumes, while Jayaweera is getting up a similar series on Ceylon Drug Plants. At the time of writing, Agricultural Extension and Young Farmers' Clubs are receiving attention, and the Divisional Agricultural Officers are writing up surveys of agricultural conditions in their respective regions.

Thus, after seventy-five years of existence, the *Tropical Agriculturist* can look back and congratulate itself on an outstanding record which has established for it a name in the libraries of the world as the leading journal on tropical agriculture. Backed by such an illustrious past, there can be no doubt that its contributions in the future will be no less valuable to the world of Agricultural Science.

Agriculture in the Southern Division

A. L. JOHNPULLE, Agricultural Officer, Southern Division

Received 28.5.56

Physical Features

THE Division comprises the three revenue Districts, Galle, Matara and Hambantota and covers an area of 2,128 square miles. On the North the Bentota Ganga forms a boundary up to about 3 miles above Pitigala. The line of demarcation then takes an undulating curve including Hinidum Pattu and Morawak Korale and such villages as Katuwana, Middeniya, Siyambalagoda and Migahajandura. The line then runs to about a mile South of Tanamalwila from where it hugs that portion of the Kirindi Oya up to Wirawila. It then connects Katara-gama and includes the Yala National Park and the Strict National Reserve. On the Eastern side it is bounded for a short distance by the Kumbukkan Oya at its mouth. The Southern, South-Western and South-Eastern portions are bounded by the sea which forms a coast line of about 162 miles.

The following rivers run through the area—Bentota Ganga, Gin Ganga, Nilwala Ganga, Walawe Ganga, Kirindi Oya, Menik Ganga and Kumbukkan Oya. These carry water during most part of the year.

Galle and Matara Districts are generally hilly, the land rising to about 2,000 feet in Hinidum Pattu and the Deniyaya area. Parts of the Bentota Walallawita Korale, Gangaboda Pattu, Wellaboda Pattu and Talpe Pattu in Galle District and Weligam Korale, Kandaboda Pattu and Wellaboda Pattu in Matara District are also hilly. Hambantota District with the exception of a small portion of West Giruwa Pattu is generally flat. Hinidum Pattu and Morawak Korale contain rolling *patanas* of the Uva type, but the *patanas* here belong to the wet type.

Soils and Climate

The soils of the Division vary a great deal in texture and composition as a result of the climatic factors. Those in the wet zones are strongly acidic in reaction and very low in bases due to the heavy leaching of the bases and consequent laterization. The nitrogen content is often low and phosphoric acid, even where it is present in fair amounts, is of low availability. These soils would therefore respond to liming and the application of fertilizers. The lime should preferably be of the dolomitic type so as to supply both calcium and magnesium. The highland soils are highly lateritic and the surface layer is often gravelly or rocky as a result of erosion. These soils are therefore suitable only for permanent crops. In the low-lying areas, soil drainage is highly impeded and in several instances the soils are peaty. Paddy is the only crop that can be grown but yields are low because of the impeded drainage.

The soils of the dry zone vary in texture from light to heavy clay loams which are found around Ambalantota and the Walawe area. These soils are generally slightly acidic in reaction and

low in nitrogen. The base status particularly of the clay loams is high. The highland soils are suitable for a variety of crops including fruit trees, provided irrigation facilities are available during periods of drought. The paddy soils often give high yields and respond to applications of nitrogen in particular and to phosphoric acid. Saline or alkaline soils occur in some areas but the high salt content of the former can be reduced by flushing and sub-soil drainage. Once the salt content is reduced an application of gypsum, would get rid of the sodium found in the clay. The alkaline soils are sticky in nature and soapy to the touch and sub-soil drainage is highly impeded. These soils can be improved by application of gypsum.

The average annual rainfall varies from 145 inches to 95 inches in the Galle District, from 147 inches to 76 inches in the Matara District and from 65 inches to 35 inches in the Hambantota District. Hiniduma in the Galle District and Morawaka in the Matara District are the wettest areas with about 145 inches and 147 inches respectively. In the Hambantota District, the greatest precipitation is recorded in the West Giruwa pattu with about 60 inches of rain while the least is in Magam Pattu where the rainfall is usually under 40 inches. Galle and Matara District and West Giruwa Pattu of Hambantota District receive the benefit of both intermonsoonal rains. East Giruwa Pattu and Magam Pattu on the other hand are only benefited by the North-East intermonsoonal rains.

Land use

Of the 1,362,360 acres, 582,131 are cultivable. Tea occupies 43,455 acres, rubber 99,095 acres, coconut 102,921 acres, paddy 136,875 acres, cinnamon 24,795 acres, citronella 30,033 acres, and chena, other cultivations, village gardens, &c., 145,044 acres.

Apart from the bigger estates employing a labour force of over 20, there are 1,382 holdings 20 acres and over in extent employing less than 10 labourer units. The cultivated extent in this group is 57,189 acres. Small holdings, i.e. those under 20 acres and over 1 acre in extent, number 75,061 and embrace a cultivated extent of 172,894 acres. Town and village gardens, i.e., those less than 1 acre in extent, number 112,259 with a cultivated extent of 50,791 acres. The cultivated extent forms 33 per cent. of the total land area in the Division. The District percentages are 46.63 for Galle, 56.13 for Matara and 13.87 for Hambantota. The total land area in each District is as follows :—Galle 413,560 acres, Matara, 308,800 acres and Hambantota 640,800 acres. Of these the total cultivable extents are recorded as 233,599 in Galle, 215,434 in Matara and 133,108 in Hambantota. The figure in respect of Hambantota apparently needs modification because apart from about 30,000 acres occupied by the Strict National Reserve and the National Park and those occupied by village forests, reserve forests, tanks, *kalapuwas* and water courses, the rest of the area can be regarded as cultivable. In any case, since only about 13.87 per cent. of the land area in this District is presently under cultivation, future development schemes must necessarily be concentrated here to relieve the acute land hunger in the other two Districts.

Population

The total population of the Division in the 1953 census was 1,140,014.

The distribution in respect of Districts and land area was as follows :—

District	Total land Area Acres	Cultivable Extent Acres	Total Population
Galle	413,560	233,599	524,382
Matara	308,000	215,424	413,904
Hambantota	640,800	—*a*	191,728

(*a*) *See remarks under land use*

Thus the cultivable extent per person in Galle District is 0.445 acre while in the Matara District it is 0.52 acre. In the Hambantota District, it is probably in the neighbourhood of 2 acres per person. These figures do not give a complete picture of the density of population in relation to land use considering the fact that of the 1,140,000 persons in the Division, 1,012,000 are rural. Besides in the Galle and Matara Districts a fair number of the population is employed in estates. But the figures give an indication of the extent of land available in the Hambantota District for the surplus population in the other two Districts. The water resources of this District are plentiful to warrant its very early development.

Land Tenure

Paddy land in the Galle and Matara Districts is mostly owned by smallholders. The extent of land is usually 1-5 acres. Several own less than 1 acre. Those owing over 20 acres are very few indeed. In the Matara District, cultivation is done on the *ande* system, the landlord's share per season in good fields being 2/3 and in poor fields ½ the yield after the following are met :—(*a*) *huwandiram* tax to Government—1/48 of the crop, (*b*) seed paddy to be returned to landlord with 50 per cent. interest, (*c*) *Paraweni* (land share) share to owner-1/10 of the crop, (*d*) *walahan* (i.e., charges for harvesting and threshing—1/7 share to the cultivator. In the Galle District, there is no *huwandiram* tax but the share is much on the same lines.

In the Hambantota District a greater portion of the land is owned by absentee landlords. The *gambaraya* system operated here till the Paddy Lands Act was introduced in 1954. The *gambaraya* leased the land from bigger land owners at a fixed rent and thereafter sublet it to tenants recovering from them at time of harvest, seed paddy loans, buffalo hire, cultivation expenses, advances to cultivators, &c., all at about 50 per cent. interest or 150 per cent. per annum. As a result of the introduction of the Paddy Lands Act, the landlord's share is now restricted to ¼ the total paddy yield for the year or 10 bushels of paddy per acre per season, whichever is less. The prescribed rent under the Paddy Lands Act is almost the same as that recovered by the *gambaraya* from the *ande* tenant prior to the introduction of the Act except where the maximum rent of 10 bushels per acre operates.

There are many difficulties in working the Act which need not however be gone into here.

Perennial Crops

Tea. The extents under cultivation in the Galle and Matara Districts are 22,153 and 21,302 acres respectively. Of these, small holdings total 8,006 and 9,002 acres respectively. The percentage out-turn of manufactured tea for the two Districts in 1951 was 22.77 (Galle) and 24.04 (Matara) while the average price was Re. 1.80 and Re. 1.83 per lb. respectively. The total quantities of green leaf produced in the two districts in that year were 338,504,000 lb. and 346,064,000 lb.

respectively. There are 309 estates of over 20 acres (73 employing ten or more resident labourers and 236 employing less than this number) in the Galle area and 364 estates over 20 acres (58 employing ten or more resident labourers and 303 less than this number) in the Matara District. The value of tea manufactured in the Galle area was Rs. 138,853,000 and that in the Matara area Rs. 152,364,000. The average yield per acre of green leaf in the Galle District was 2,713 lb. while that in the Matara District was 2,681 lb. In 1953, a Co-operative Tea Factory for processing the green leaf from smallholders was opened at Kotapola in the Matara District. Blister blight (*Exobasidium vexans*) affected 6.60 per cent. of the tea area in the Galle District and 20.92 per cent. of that in the Matara District.

Rubber. The total acreage under the crop inclusive of smallholdings in 1951 was 72,158 in Galle District and 26,937 in Matara District. Of these small holdings, i.e., those under 20 acres in extent totalled 37,921 acres in Galle and 15,264 acres in Matara District. This Division thus contains 15 per cent. of the total rubber area of the Island. Of the estates over 20 acres in extent approximately 19,293 acres in the Galle District and 4,895 acres in the Matara District contain trees which are over 30 years old. In this same group, only 3,001 acres in the Galle District and 3,726 acres in the Matara District contain trees 6-30 years old. In connection with the replanting scheme of Government a total of about 76,000 clonal seedlings of Tj. I raised in the Agriculture Department nurseries have been so far issued to smallholders. Further issues will be made during the coming seasons. Highly-yielding rubber in estates over 20 acres totalled 11,792 acres in the Galle District and 2,881 acres in Matara District. The production of dry rubber in estates over 20 acres in extent in 1951 was 119,368,000 lb. in the Galle District and 34,368,000 lb. in Matara District.

Coconut. The total area under this crop is 102,921 acres. This forms 11.18 per cent. of the total coconut area in the Island. No systematic planting has been done in most of the small holdings with the result the trees are crowded and yields are low. About a third of the extent (33,567 acres) is over 30 years old. Re-planting has to be done. A start has been made in this direction by making available to cultivators at a nominal rate seedlings from selected mother trees. There are at present two such nurseries maintained by the Coconut Research Scheme at Labuduwa and Bedigama. A third nursery is to be opened at Koggala. A scheme of subsided fertilizers has been recently introduced to rehabilitate the industry. The average yield of nut per acre from estates is 1,145 and from small holdings 686 compared to 1,797 and 997 respectively for the entire Island.

Citronella. The estimated acreage is 30,015 of which 11,470 are in the Matara District and the rest in the Hambantota District. Two varieties of grass are grown, viz., *Mahapangiri* and *Lenabattu*. The latter is the hardier variety and covers about 75 per cent. of the total acreage. The geraniol content of the former is about 70 per cent. and that of the latter about 54 per cent. Harvesting is done about 3-4 times a year.

The price of oil during the period 1948-1951 was very favourable. It averaged Rs. 7.94 per lb. in 1951. The

highest price fetched was Rs. 11.41 per lb. in March 1951. Thereafter there was a sharp drop till 1953 when it fetched about Rs. 1.75 per lb. The current price is Rs. 3.80 per lb. of Estate quality oil and Rs. 3.60 per lb. of F.A.Q. oil.

Distilling is done on a share basis, the usual share being 1/6—1/7, the quantity of oil extracted. There are about 350 distilleries in the Division. The extraction efficiency of these is poor. The average yield per acre under these conditions can be reckoned at about 50 bottles per acre. It has been found that with a lighter pack in the distilling process a higher percentage of extraction is possible.

A scheme to rehabilitate the industry by the introduction of better strains of grass, by selection of better strains of *Lenabattu* and by improvement of distilling methods is receiving the attention of the Government. Some of the citronella, particularly in the Matara District, is being gradually replaced by more remunerative crops like coconut and rubber.

Cinnamon. Of the 33,000 acres under cinnamon in the Island, 24,704 acres are in the Division and are confined to the Galle (14,885 acres), Matara (9,636 acres) and Hambantota Districts (183 acres). The best quality cinnamon bark, however, is that produced in the Negombo District. In addition to bark, cinnamon leaf oil and cinnamon bark oil are extracted from the plants. The quills are graded into (*a*) Fine, (*b*) Barcelonas, and (*c*) Hamburgs. For present trade purposes, only Fine and Barcelonas are quoted. The bulk of the former comes from the Western Division while that produced in the Southern Division mostly constitutes the latter grade. Usually two crops are taken a year. Peeling is done mostly on the share basis, the peelers receiving half the value of the quills, chips and featherings. Cultural treatment consists of weeding once in six months and cleaning of bushes once a year. If the crop is good and the bushes healthy, two crops are taken a year by cutting the shoots which are about 6-8 feet long. Usually the leaves are mulched round the plants at the time of harvest. In some cases, however, when the cultivator is in need of ready money, oil is extracted from the leaves. When this is done, there is a fall in the yield of quills in the subsequent season. Harvesting is done in May/June and December. Average yields are 400 lb. quills per acre. Present prices are favourable, quills Fine fetching Rs. 3.75 per lb., quills No. 2 fetching Rs. 3.10 per lb., chips per candy of 560 lb. fetching Rs. 100, cinnamon leaf oil Rs. 9.75 per bottle and cinnamon bark oil Rs. 4.50 per oz.

Other Crops. A distribution of seedlings of coffee of the *Robusta* variety and pepper rooted cuttings during the past few years has resulted in a fair number of village gardens in the Galle and Matara Districts having a few coffee bushes and pepper vines. The latter is also found in West Giruwa Pattu of the Hambantota District particularly in the Middeniya area.

Fruit plants cultivated are jak, mangoes, citrus, mangosteen, durian, rambuttan, pineapples and plantains in the Galle and Matara Districts and jak, citrus, mangoes, plantains and pineapples in the Hambantota District. The Tissamaharama area produces some of

the best plantains. This crop is grown extensively in this area and in the Middeniya-Weeraketiya section.

Annual Crops

Paddy. Although a total acreage of 136,878 has been reported in the 1946 census of which 38,560 are said to be uncultivated, a survey carried out in 1952 indicated that the extent cultivable, provided favourable weather is present, is 128,847 acres in *maha* of which 40,603 acres are in the Galle District, 49,978 acres in the Matara District and 38,266 acres in the Hambantota District. This survey also revealed that only 80,371 acres are ploughable (17,454 acres in the Galle District, 21,148 acres in the Matara District and 31,769 acres in the Hambantota District) and that as the rest of the area was mostly swampy, transplanting was possible only in 43,657 acres, weeding in 73,212 acres and harrowing of the standing crop in 54,836 acres.

In *yala,* the extent cultivable was 123,529 acres (49,379 acres in the Galle District, 47,857 acres in the Matara District and 26,293 acres in the Hambantota District). Of this 63,707 acres were ploughable, 39,951 acres transplantable, 63,618 acres weedable and 48,862 acres where the growing crop could be harrowed.

Most of the paddy in Galle and Matara is grown under rain-fed conditions. Irrigation facilities, major or minor, are provided for only 1,692 acres in *maha* and 2,747 acres in *yala* in the Galle District and 10,394 acres in *maha* and 9,496 acres in *yala* in the Matara area. In the Hambantota District on the other hand, most of the paddy is irrigated (28,739 acres in *maha* and 23,695 acres in *yala*). The major irrigation works are :—the Walawe Scheme 12,670 acres, the Kirindi Oya Scheme 9,300 acres, the Urubokka Oya Scheme 4,100 acres, the Kirama Oya Scheme 3,600 acres, Hali Ela and Elawala 4,600 acres, Kekanadura 1,200 acres, Denagama, Urugamuwa and Dandeniya 1,700 acres.

Paddy cultivation is done in the Matara and Hambantota Districts with the aid of *Vel Vidanes.* In the Galle District, with few exceptions, the post of *Vel Vidane* has been abolished.

Some of the more popular paddy varieties grown are detailed below :

Galle District

MAHA		YALA	
Variety	*Approximate Acreage*	*Variety*	*Approximate Acreage*
Sulai	19,350	Sulai	16,500
Handiran	9,700	Kaharamana ..	11,200
Madael	4,500	Handiran	10,900
Kaharamana ..	3,500	Dewareddiri	5,100
Podiwi	2,000	Madael	3,300
Balamawi	2,000	Gires	2,000

Matara District

MAHA		YALA	
Variety	*Approximate Acreage*	*Variety*	*Approximate Acreage*
Horanamawi ..	20,300	Suduratawi ..	17,400
Balamawi ..	13,300	Arnolia ..	5,500
Mahamawi ..	2,800	Sulai ..	3,600
Sulai ..	1,900	Heendikwi ..	3,500
Podiwi ..	1,060	Kaharamana ..	2,750
Kaharamana ..	1,000	Mahadikwi ..	2,175
		Suduheeneti ..	2,000
		Ratawi ..	1,750
		Kombila ..	1,700
		Sinnanayan ..	1,175

Hambantota District

MAHA		YALA	
Variety	*Approximate Acreage*	*Variety*	*Approximate Acreage*
Sinnanayan 398 ..	8,450	Sinnanayan 398 ..	7,950
Rathkarayal ..	5,080	Suduheeneti ICPY 15 ..	4,620
Suduheeneti ICPY 15 ..	4,570	Rathkarayal ..	4,330
Hondarawalu ..	2,850	Kaluwi ..	1,600
Ratranwi ..	2,800	Mahasuduwi ..	1,430
Godamawi ..	2,560	Pachchaiperumal ..	1,400
Suduheeneti Hf 9 ..	1,350	Suduheeneti Hf 9 ..	1,340
Mahasuduwi ..	1,230		
Karayal ..	1,150		
Balamawi ..	1,080		

Most of the paddy varieties grown in the Galle and Matara Districts are awned and the only pureline selection available for *maha* and *yala* so far is *Sulai*. Recently the selections *Murungakayan* 302, and *Mas* M 24 have been introduced for trial. Selection work on some of the varieties listed earlier is in hand and it is expected that some of these will be available shortly. The extent under purelines in the Galle District is about 7,400 acres in *maha* and 5,500 acres in *yala*. In Matara, the acreages are 3,100 in *maha* and about 2,000 in *yala*. In the Hambantota District, about 16,300 acres in *maha* and 12,050 acres in *yala* are under the selections *Sinnanayan* 398, *Sinnanayan* 2208, *ICPY* 15, *Rathkarayal, Pachchaiperumal, Pokkali* and *Vellai Illankalayan*.

Considerable attention has been given to the stepping up of yields of paddy by carrying out demonstrations on the several methods of improving yields. But until the problem of drainage which effects about 60 per cent. of the fields in the Galle and Matara Districts is solved, the average yield in these areas will necessarily remain low. Because, whatever increases are effected in the remaining 40 per cent., the low yields consequent on flooding, swampy conditions, &c. in 60 per cent. will bring down the general overall average for the Districts.

A second factor which affects cultivation is the shortage of plough animals in these two Districts. Thus the buffalo population in these Districts is 15, 184

compared to the vast acreage of about 99,000 under paddy. The cultivators with exceptions have still not got accustomed to the habit of using neat cattle for cultivation. This has necessarily resulted in such practices as good preparatory tillage and harrowing of the growing crop being restricted. It should also be noted that although both these Districts receive an annual precipitation of about 100 in. of rain a year, the effective value of this rain to the paddy cultivator is very often low in that adequate rain water is not always available to undertake a good preparatory tillage, to weed their growing paddy and to harrow the standing crop. Very often after the crop is sown and during the growing period there is a long spell of dry weather at the time water is most needed for weeding and harrowing of the standing crop and this results in the young plants being stifled by weeds mostly Kudametta (*Fimristylis miliacea*). Preparatory tillage by light tractors immediately after harvest was introduced in 1953 with a view to overcoming some of the difficulties attendant on an uncertain rainfall but has not made much progress.

In the Hambantota District, the main difficulties are the shortage of manpower to work the fields and the evils of the *gambaraya* system which does not allow much scope for the cultivator to adopt improved methods of cultivation. Mechanical cultivation was introduced about 10 years back to get through the sowing operations in time. This has proved useful and there are now several privately owned tractors in the District. The Paddy Land Act was introduced in 1954 to combat the evils of the *gambaraya* system but in view of several shortcomings in the Act very little headway has been made. Threshing of paddy in the Galle and Matara Districts is done by foot. In the Hambantota District, buffalo threshing is the common practice but threshing with tractors is becoming popular now.

The following are the approximate acreages under improved methods of cultivation in *yala* 1955 and *maha* 1955-56 :—Good preparatory tillage 15,900 acres in *yala* and 20,300 acres in *maha*, fields green manured or which received an application of compost of cattle manured, 9,490 acres in *yala* and 8,900 acres in *maha ;* transplanted, 1,200 acres in *yala* and 2,860 acres in *maha ;* fields which received a dressing of fertilizers, 28,130 acres in *yala* and 27,210 acres in *maha ;* fields where the standing crop was harrowed, 11,900 acres in *yala* and 15,480 acres in *maha ;* row sowing with germinated seed, 1½ acres in *yala* and 265 acres in *maha*.

Attention is drawn to the last improved method of cultivation detailed above, viz., **that of row-sowing germinated paddy.** This was first devised in this Division in early 1955 with the advent of the Japanese weeder in 1954 after studying the causes of the failure to make appreciable progress with transplanting of paddy. It should be noted that the maximum so far transplanted out of the vast acreage in the Division was 2,860 acres in *maha* 1955-56. There are several difficulties with regard to the wide adoption of this method. Chief among these are, the high cost, high labour requirement and the availability of water at the time of transplanting. Row sowing of germinated paddy followed by the use of the Japanese weeder is the answer judging by the yields obtained and the eagerness with which the cultivator is taking to this

method. There is a minimum increase of about 10 bushels per acre. It is expected that within the next few seasons the entire non-swampy tracts of the fields in the Division will be cultivated by this method.

Cotton. The crop is grown in *chenas* in East Giruwa Pattu and Magam Pattu of the Hambantota District. The acreage has fallen recently due to the high handling charges levied by the agency purchasing the seed cotton. The estimated acreage in 1955-56 was about 2,500. The variety grown is the selection B. P. 79. Average yields under chena conditions vary from 1½-2½ cwt. per acre. In the Meegahajandura-Gonnoruwa area, yields of 4-5 cwt. per acre are common.

Sugar Cane. This is cultivated in about 750 acres in the Nagoda-Baddegama area, each cultivator growing about ¼-½ acre. The area is subject to regular flooding by the Gin Ganga. The varieties grown are mostly the selections CO 411, CO 281 and CO 349, planting material for which was distributed by the Department of Agriculture during 1947-1951. About 5-6 ratoons are taken. Crushing is done by 5 bullock-worked mills, the cultivator receiving 2/3 the crude sugar manufactured.

Other Annual Crops. The crops grown are chillies about 3,750 acres in *maha* and 1,200 acres in *yala ;* kurakkan about 1,500 acres ; green gram about 1,650 acres in *maha* and 400 acres in *yala ;* meneri about 200-400 acres each season ; vegetables about 3,900 acres in *maha* and 2,600 acres in *yala ;* sweet potatoes about 4,300 acres in *maha* and 3,300 acres in *yala ;* cassava about 7,200 acres in *maha* and 5,700 acres in *yala* and other root crops about 1,100 acres in *maha* and 1,200 acres in *yala*. Most of the chillies, kurakkan, maize and a fair proportion of the other crops are grown in *chenas.*

Livestock

In the 1946 census, the livestock population was enumerated as 125,125 cattle, 33,268 buffaloes, 14,287 goats, 350 pigs, 66,830 fowls, 1,072 ducks, 456 turkeys, 34 geese and 234 guinea fowls. These numbers have since increased considerably particularly in regard to poultry, goats and pigs. There is still much prejudice among the village population against the systematic rearing of stock. This prejudice is, however, being gradually broken down. Apart from a few well-established dairies in the three Districts, quite a number of the cultivators in the Galle and Matara Districts and some in the Hambantota District maintain a cow or two for milk. In very many instances, no attention is paid to the animals but at calving the milk is utilised. The animals, as a rule, are of the Sinhala breed and produce on an average only about 1-2 pints of milk. In the Hambantota District, the animals are allowed to roam in the jungle and very few cultivators are actually aware of the number they own. The animals are periodically rounded up for sale to the butcher.

Much work has been done by Government during the past few years by the issue of purebred Indian bulls of the Scindi and Sahiwal breeds for the grading of cattle and there are at present several hundreds of cross-bred animals. During the last three years the number of services given by such bulls was well over 2,700. Along with the

issue of stud bulls, castration of unwanted bull calves has been done. Attention has also been paid to the housing and feeding of cattle and in this process several small plots of fodder grasses have been established in village gardens and over 2,000 sheds constructed to house the animals. Artificial insemination has been introduced and there are two centres at present, one in Galle and the other in Matara.

Of the buffalo population of 33,268 in the Division, 18,084 are concentrated in the Hambantota District. The animals are seldom looked after. They are rounded up prior to each cultivation season and driven into the jungle after the preparatory tillage and harrowing-of-the-growing-crop operations are completed. When the paddy is harvested, the temporary fences are opened and both the neat cattle and the buffaloes allowed to graze on the stubble. The she-buffaloes are milked and the milk converted into curd. There is a ready sale for the curd which fetches about Rs. 2.50 per pot. Crossing of the local buffaloes has been undertaken with the Murrah breed and there are a few cross-bred animals at present. The response to making use of the stud buffaloes offered by Government has been poor, due to the fact that the buffaloes are allowed to forage in the jungle and are accordingly not looked after. Consequently the cultivators are unware of the time the animals come into heat.

Improvement in the grading of the indigenous goats has been effected by the issue of the Bangalore and Jamnapari breeds to breeders. During the last three years about 1,000 services have been given by these animals. Arakan animals have also been introduced to improve the milk yield. But work in this direction has been handicapped by the non-availability of a sufficient number of stud animals owing to the ban on imports from India. One draw-back with the Indian breeds is that they are susceptible to Goat Paralysis. Two Goat Breeding Societies have been formed in the Hambantota District. In this area there is scope for raising a fair number of the Island's annual requirement of goats. A scheme to alienate land for this purpose in blocks of 50-100 acres each is receiving the attention of Government.

Much work has been done towards grading the poultry in the villages by the sale of cockerels, chicks and eggs. The breeds popular are white Leghorns, Rhode Island Reds and Australorps. Although several of the middle-class have taken to poultry-rearing, religious prejudice still acts as a deterrent towards the peasant readily taking to it. During the past three years about 1,200 cockerels, over 23,600 hatching eggs and 6,625 chicks or pullets have been sold for breeding purposes. There are three Poultry Breeding Societies in the Hambantota District.

Pig-rearing is becoming popular with the planting community in the Galle and Matara. Districts. The number actually engaged in it is however few. The animals are sold as pork for which there is a ready sale.

Pests and Diseases

There have been regular outbreaks of the Pentatomid bug in the Hambantota District. This appears to be confined mainly to the Walawe basin. In this area

the outbreak involved about 3,700 acres in *yala* 1954, about 8,000 acres in *maha* 1954-55, about 4,000, acres in *yala* 1955 and about 2,000 acres in *maha* 1955-56. This pest assumed epidemic proportions for the first time in 1939. Thereafter sporadic outbreaks have taken place till 1953. These were followed by the major outbreaks detailed above. Although isolated outbreaks of this pest have occurred throughout the Island and have been brought under control, such outbreaks have not persisted as in the case of the Walawe area. In this area it is apparent that there is some factor favouring the multiplication of the bug. Free issues of insecticides have been made by Government for the control of the pest since 1954. Arkotine and Dieldrin were used first but were found to be expensive. Besides two or three sprayings had to be given before effective control could be achieved. In the last two outbreaks Folidol E 605 which was found to be more effective and far less expensive was used. It was also found that one spraying with this insecticide was usually sufficient to bring the pest under effective control. Observations carried out in the Division have shown that the infestation is heaviest when the plants are 10-12 days old and that spraying of infested areas should commence at least two weeks from sowing. Egg-laying on wild grasses, in addition to the paddy plants, was observed in 1955.

Sporadic outbreaks of other pests, such as the paddy-swarming caterpillar, paddy stem borer, paddy fly, thrips on paddy, cotton leaf roller and cotton boll worm occur. *Helminthosporium* and *Piricularia* on paddy present a problem in the Wet Zone areas. Frequent outbreaks of these two diseases take place causing much damage to crops. Recently outbreaks of *Piricularia* have also been reported in parts of the dry zone.

Of noxious weeds Water Hyacinth (*Eichornia crassipes*) still presents a problem in the Hambantota District. Modern methods of control with 2, 4 —D weedicides are being carried out. The recently introduced *Salvinia auriculata* is widely found along the coastal areas of Galle and Matara Districts. No systematic eradication has been undertaken so far.

Agricultural Education

Three Farm Schools, one of which is for girls, train village boys and girls in modern methods of farming. A Girls' Farm School was opened only in 1952 at Labuduwa, near Galle. Each school can accommodate up to 30 students. So far, 658 boys and 57 girls have completed their courses. Although the intention was that these students should get back to the land, most of them have actually secured employment on estates and as overseers and demonstrators under Government. Agricultural Education is also carried out through the agency of Young Farmers' Clubs of which there are 52 either registered or in the process of registration. The membership of these clubs is 460 boys and 240 girls.

Future Lines of Development

The prosperity of the Ruhunu country lies in the proper utilization of its water resources of which there is an abundance. Schemes receiving consideration at present are bringing in about 40,000 additional acres under the Walawe Ganga and 12,000 additional acres under

Kirindi Oya. These by themselves would not be sufficient. The utilization of all the land under command of the other two rivers Menik Ganga and Kumbukan Oya has to be investigated fully. In this process it may be necessary to consider the question of moving the game sanctuary higher up so that the Hambantota District and some of the land north of it may form one vast fertile plain eventually linking up the Eastern Province by rail and road along the coast. Balanced Resource Development should be the keynote of this scheme. It should provide for stock raising integrated with arable farming, raising of plantation crops, such as, coconuts and the proper exploitation of its sea resources which cover about 162 miles. It should also be possible to harness the rivers for production of cheap energy for domestic and industrial needs.

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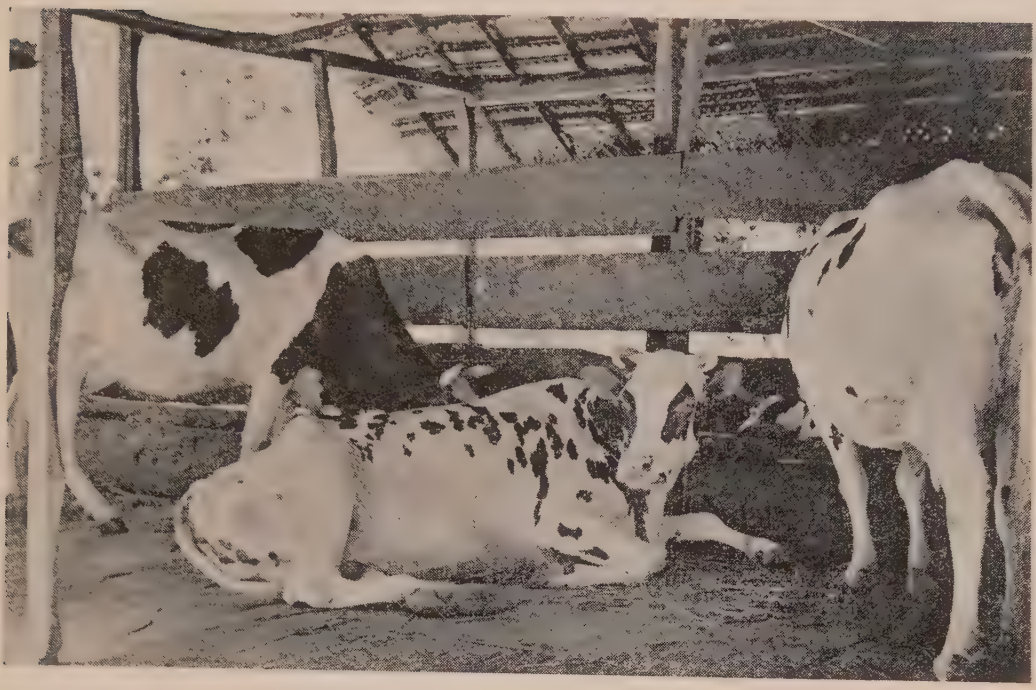

Prize Winning Herd— All-Island Competition, 1955.

Citronella Oil Distillery.

Swampy Paddy Fields characteristic of the Galle and Matara Districts.

Destructive Paddy Pest—The Pentatomid Bug (within rectangle) and egg mass (within circle).

Economic Damage and Control of the Cacao Capsid, *Helopeltis* sp. (fam. *Capsidae*, ord. *Hemiptera*) in Ceylon

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Introduction

Numerous members of the family *Capsidae* to which *Helopeltis* belongs are notorious, wherever they occur, for the drastic toxic effects and economic damage they cause on cultivated plants during the course of their feeding. The cacao plant in most regions of the world is susceptible to attack and damage by a number of species of Capsid bugs belonging to the genera *Sahlbergella, Distantiella, Helopeltis* and *Bryocoropsis*. The type of injury caused by all these bugs is generally similar in that the primary damage surrounds the point of insertion of the stylets into the plant tissue of young shoots, leaves or pods. In Ceylon, only one species of Capsid bug, *Helopeltis antonii*, has been recorded as attacking cacao. This species was first recorded in 1880 as causing a serious die-back of cacao shoots in the Matale district. More recent studies by de Silva (1956) of the Division of Entomology in collaboration with the Commonwealth Institute of Entomology, suggest that an entirely new species of *Helopeltis* is responsible for damage to cacao plants in the main cacao-growing regions of the Island. Hence the species of *Helopeltis* being dealt with in this paper will be referred to as *Helopeltis sp.*

The severe economic damage caused by the *Helopeltis sp.* in Ceylon has necessitated a series of biological, ecological and control studies of this pest. The description of the new species of *Helopeltis* predominant on cacao in Ceylon today, its detailed biology, &c., will be dealt with separately by de Silva in due course. This paper is mainly concerned with a review of the economic damage caused to cacao in Ceylon by *Helopeltis sp.*, a comparison of this damage with that caused by related Capsids in other countries and the insecticidal control trials conducted to date against the pest in Ceylon.

Habits and Nature of Damage

Helopeltis sp. is found in all cacao growing areas in Ceylon but the heaviest damage to the crop is recorded in the plantations in the Dumbara Valley. It feeds at all hours of the day and usually is found on pods of all ages feeding on the shaded sides. Damage to cacao by this pest is rapid and spectacular. All stages of *Helopeltis sp.* feed on the plant juices of the crop and while feeding is mainly on the pods, less frequently young stems and shoots or leaves are also attacked. Within 2 to 4 minutes of the insertion of the stytets into the plant tissue for feeding, what is frequently referred to as a " water-soaked " circular area of tissue develops around the point of insertion. This " water-soaked " area increases in diameter to between 3 and 6 mm. as feeding by an adult bug on a pod continues. The diameter of this area on young stems is considerably greater ranging up to 8 or 10 mm. The diameters of the lesions caused by the younger

Plate 1.—Cacao pods attacked by *Helopeltis sp.* Note the concentration of attack in the shaded zones of the pod.

Plate 2.—Lesions caused by *Helopeltis sp.* on young stem of cacao plant.

stages are smaller. The " water-soaked " area is initially deep translucent green but within a few hours becomes depressed and deep brown. In a few days after feeding these lesions become almost black. A single adult bug has been found to be able to produce up to as many as 60 such lesions in a 24-hour period of feeding. On pods therefore *Helopeltis* damage appears in the form of numerous circular areas of depressed brownish to blackish dead tissue while on stems these areas are larger and usually oval rather than circular. In the case of the Capsids, *Salhlbergella singularis* Hagl. and *Distantiella theobroma* (Dist.) which occur in the Gold Coast of West Africa, Goodchild (1952) has shown that the primary " water-soaking " effect surrounding the point of insertion of the stylets in feeding by these bugs is due to the histolytic effect of esterases in the saliva injected into the wound. No organic pathogenes have been found in the saliva of these species. The primary wounds caused by these bugs are said to be subsequently invaded by the fungus *Calonectria rigidiuseula* and this is said to aggravate the damage done to the plants by *Helopeltis*. It is most likely that the same holds true for *Helopeltis sp.* in Ceylon, but investigations are presently under way to clarify these points.

As a consequence of the feeding of *Helopeltis sp.* on cacao, economic loss of crop may result in several ways. Young pods attacked by these bugs frequently fail to develop further, may be invaded by the fungus *Phytophthora palmivora* and are shed prematurely. Older pods atacked by this pest exhibit concentrated spotting (Plate I) which is responsible for the retardation in growth or the malformation of these pods. Such damage on older pods frequently attracts subsequent attack by the cacao pod-boring caterpillar, *Dichocrocis punctiferalis* Gn.

Attack by *Helopeltis sp.* of the young shoots or growing stems results in collapse, death and browning of areas of the superficial tissue (Plate 2). When concentrated, as is usually the case whenever attack of stems occurs, the growing shoot first dies and a die-back sets in which frequently affects the entire new growth. The leaves on damaged stems dry up and are shed. Consequently the young growth is represented only by the withered twigs on the plant (Plate 3). Cacao plants in this condition caused by Capsid attack in West Africa have been referred to as " stagheaded ". Initially this type of attack causes a reduction in the canopy of the plant. If this attack is not checked by the various remedial measures and is allowed to repeat itself with each appearance of new flush the plants are ultimately killed.

In Ceylon, the *Helopeltis sp.* concentrates its attack on cacao pods. However, extensive attack of shoots and stems of old and young plants by this pest, with consequent die-back and even death of plants, has been observed especially where shade is inadequate as a consequence of bad pruning or neglect. The reasons why this pest which normally feeds and multiplies on cacao pods, and this too commencing from the shaded areas, should attack extensively the young stems and shoots of cacao plants when the normal shade is depleted is not clear, and close investigation is required to elucidate the factors involved. The relationship between damage by capsids and overhead shade or the cacao canopy has been studied widely in

Plate 3.—" Stagheading "—Die-back of young flush and stems due to *Helopeltis* attack under poor shade.

Africa but the various workers are not agreed, hence the basic factors involved are still obscure. (Taylor 1954, Posnette 1943, Williams 1953).

A frequent observation on damage by *Helopeltis sp.* to cacao pods in Ceylon is a highly concentrated attack on a few or all the pods of a particular tree or trees, whereas pods on other trees are left undamaged. While no work has been done to elucidate this point in Ceylon, attempts have been made in Africa to obtain cacao resistant to Capsid attack (Taylor 1954) but field trials have finally shown no significant differences in susceptibility of the selections and ordinary West African Amelonado cacao to Capsid attack. In Ceylon too, it is most likely that the heavy attack observed on pods of certain plants and the relative freedom from attack of other plants is more the result of heavy egg-laying and nymphal feeding by *Helopeltis* dependant upon the distribution of gravid females in the plantation rather than to specific features of the cacao plants which render them more attractive or repellent to attacks by this bug.

While no parasites or predators of this pest have been recorded in Ceylon it has been observed that wherever the red ant *Oecophylla smaragdina* is present on cacao pods tending mealy bug populations, *Helopeltis* damage is extremely rare.

Control

The heavy damage and losses caused by *Helopeltis* and other Capsids to the cacao crop and its harvests have necessitated repeated attempts at the development of effective control measures against this pest in many parts of the world.

Before the development and extensive use of the synthetic organic insecticides, preparations, such as, kerosene emulsion (Dudgeon 1910) Nicotine Sulphate sprays and dusts (Cottrell 1926) lime sulphur and Tropical Mortegg (Cottrell 1943) and derris dusts (Betrem 1940, 1941 ; Verbeek 1924) were used for the control of the Capsid bugs, but as can be expected the results achieved were poor. When the insecticides DDT and gamma BHC became available various workers reported successful control of Capsids with formulations of these insecticides. (Harrison *et al* 1948 ; Nichol 1950 ; Taylor 1954.)

In Ceylon the earliest experiments with synthetic organic insecticides were directed at evolving suitable control measures against *Helopeltis sp.* by the use of spray techniques. The type of terrain and equipment limitations restricted our earlier trials to the use of either knapsack sprayers with long spray lances or to the power driven mist blower (J. Duiker & Co., The Hague, Holland) of the type which could be normally operated when slung on the shoulders of a spray operator (Fernando *et al* 1954). With knapsack sprayers supporting 8-foot spray lances it was found that satisfactory control of *Helopeltis* could be obtained if spraying was done with a DDT emulsion prepared by mixing 1 fluid ounce of a 25 per cent. DDT emulsifiable concentrate in 2 gallons of water and spraying the pods and bases of the larger branches of the plants at the rate of about 40 gallons of the prepared spray per acre. Similar satisfactory control of this pest was obtained when low volume spraying was carried out with the mist blower. In this case the spray was prepared by mixing 2 pints of a 25 per cent. DDT or 20 per cent. Dieldrin emulsifiable concentrate with water to make 1½ gallons of spray and applying this concentrated spray to the pods and main branches at the rate of about 1½ gallons of spray per acre.

Administration of insecticides for the control of *Helopeltis* by spray techniques where each plant required individual attention, was found to be tedious and slow unless a very large number of sprayers and spray operators were engaged in the operations at the same time on a large plantation. The slowness of the operations therefore prevented control of the pest over wide areas in a short period of time so that reinfestation of treated areas from untreated areas invariably occurred. Generally the satisfactory spray treatments mentioned gave residual insecticidal protection of the crop from *Helopeltis* attack for a period of about one month, at the end of which reinfestation by the pest always occurred. Hence spraying of the cacao crop had to be repeated at monthly intervals for complete protection of the crop until harvest. The same spray schedule was found to be effective in the control of *Helopeltis* attack on

young shoots and stems but spraying could be discontinued soon after the stems and flush hardened.

In view of the slowness and tediousness of spraying operations on the cacao crop and the necessity to repeat such spraying at monthly intervals in order to prevent reinfestation of the crop by *Helopeltis,* it was felt that experiments to evaluate the effectiveness of insecticidal dust formulations and dusting techniques should provide the most fruitful line of further research on the control of this pest. Furthermore, a very handy and efficient light power duster which could be operated from the shoulders of an operator had become available (Plate 4.)

Trials to evaluate the effectiveness of a series of insecticidal dusts in *Helopeltis* control were initiated at the peak of an attack by this pest in August 1955 at Mahaberiatenne Cacao Estate, Teldeniya. Five to eight-acre blocks of cacao separated from each other, but within the same plantation, were selected for the dusting trials. Pods of all stages of development were present on the trees and *Helopeltis sp.* was very apparent on most plants. A day before dusting, 25 to 80 plants carrying *Helopeltis* infestations were selected at random in each 5-8 acre block. As many pods as possible on these plants with obvious *Helopeltis* populations as nymphs were then selected at random. A count of adult bugs present before treatment and 24 hours after treatment with insecticides on the selected plants was carried out and recorded. A similar

Plate 4. Dusting a plantation with the Mistral I duster to control *Helopeltis sp.*

count of nymphal stages of the bugs on the selected pods of these plants was made and the counts recorded and also noted on aluminium foil labels attached to the pods. Two or three pods entirely free of *Helopeltis* were marked with red labels on the selected plants for maintenance of observations on reinfestation by *Helopeltis* after initial control by dusting had been achieved. Preliminary observations on *Helopeltis* populations on cacao pods showed that while populations of adult bugs fluctuated within 24-hour periods, those of nymphs showed no fluctuations in this period of time. Where differences in populations of nymphs on a given pod occurred within a 24-hours period this was usually found to be the result of the last nymphal instars changing to adults which flew away. That this had happened was usually indicated by the presence of the cast skins on the pods.

Dusting was carried out with a "Mistral I" power duster, (Birchmeier Cie AG. Kunten), which is a light duster of high efficiency (Plate 4) and ideally suited for dusting operations on the cacao crop under local conditions. The purpose of this trial was to assess the effectiveness of various insecticidal dusts in controlling existing populations of *Helopeltis* and also in preventing reinfestations of cacao by this pest. Areas were dusted in parallel tracts and 5 to 8 rows of cacao plants being covered at a time. About 10 pounds of insecticidal dust was used per acre to obtain good coverage of the plants under still conditions. A 5-acre block was dusted in about 45 minutes and under normal operational conditions about 35 acres of cacao can be dusted in an 8-hour day with a single duster.

The results of the dusting trial where six insecticidal dusts were tested for their effectiveness in immediate control of existing *Helopeltis* populations are presented in Table I. These results would indicate the gamma BHC 1.3 per cent. dust, Endrin 1.5 per cent. dust and Dieldrin 1 per cent. dust gave complete control of the pest within 24 hours after treatment. Aldrin 2.5 per cent. dust, gamma BHC 0.65 per cent. dust and DDT 5 per cent. dust gave relatively poor control of the pest. In view of the particularly poor control of the *Helopeltis* with Aldrin dust, tests with this product were not pursued further. The treated plots were examined 2 weeks after treatment in order to assess the incidence of any freshly hatched nymphs from eggs which existed in the pods during the first dusting (eggs hatch in about 10 days). Such nymphs were found only in the plot treated with the 0.65 per cent. gamma BHC dust. In this case the dusting was repeated and the complete control of the bugs was achieved.

Observations were maintained approximately at monthly intervals on the marked clean pods on the selected plants with a view to assessing accurately the period of freedom of the plant from *Helopeltis* after the insecticidal treatments, and also for timing the next treatment. Records were also maintained of the clean and attacked pods other than those labelled for observations of onset of infestation on the selected plants. It was expected that while observations on the labelled pods would give an accurate indication of the onset of reinfestation of the plants by *Helopeltis,* those on the other pods of these plants would give a fair idea of the value of the control operations in terms of protected crop. Table 2 represents the

TABLE 1—Control of *Helopeltis sp.* by Dusting Cacao with a series of Insecticidal Dusts at the rate of 10 lb. dust per Acre.

Insecticide and Strength of dust used	*Acreage Treated*	*No. of trees under observation*	*No. of pods under observation*	*Bug infestation before dusting*			*Bug infestation after dusting*			*Per cent. mortality of bugs, 24 hrs. after dusting*
				Adult bugs	*Nymphs*	*Total No. of Bugs*	*Adult bugs*	*Nymphs*	*Total No. of bugs*	
Aldrin 2.5% dust ..	5 ..	25 ..	69 ..	18 ..	229 ..	247 ..	4 ..	66 ..	77 ..	71.66
DDT 2.5% dust ..	5 ..	25 ..	51 ..	5 ..	129 ..	134 ..	0 ..	18 ..	18 ..	86.56
Gamma BHC 0.65% dust ..	8 ..	80 ..	177 ..	47 ..	913 ..	960 ..	3 ..	101 ..	104 ..	89.06
Dieldrin 1% dust ..	5 ..	25 ..	73 ..	33 ..	393 ..	426 ..	0 ..	2 ..	2 ..	99.53
Endrin 1.5% dust ..	5 ..	25 ..	32 ..	1 ..	90 ..	91 ..	0 ..	0 ..	0 ..	100
Gamma BHC 1.3% dust ..	5 ..	25 ..	60 ..	8 ..	145 ..	153 ..	0 ..	0 ..	0 ..	100

TABLE 2— Effectiveness of a series of Insecticidal Dusts in preventing attack of Cacao pods by *Helopeltis sp.*

Insecticidal Treatment	*Acreage Treated*	*No. of trees under observation*	*Dates of treatments*	*Dates of observations*	*Condition of Observation Pods*		*Condition of other Pods*		*Per cent. observation pods free from attack*	*Per cent. other pods free from attack*	*Increase or Decrease in per cent. free pods (other) in period of the treatment*	*Period of freedom of crops from bug attack after treatment*
					Clean	*Attacked*	*Clean*	*Attacked*				
Gamma BHC 0·65% dust	8	30	12. 8.55	23. 8.55	81	—	193	459	—	29·7%	14·1% increase in 3·5 months approx.	2·5 months approx.
			23. 8.55	28. 9.55	81	—	262	434	100%	37·5%		
				11.10.55	81	—	289	413	100%	41·2%		
				10.11.55	69	12	284	493	85·2%	36·6%		
				21.12.55	69	12	405	521	85·2%	43·8%		
Gamma BHC 1·3% dust	5	20	18. 8.55	31. 8.55	56	—	84	208	—	28·8%	24·7% increase in 3·5 months approx.	2·5 months approx.
				28. 9.55	56	—	140	188	100%	45·7%		
				11.10.55	56	—	134	188	100%	44·7%		
				10.11.55	49	7	111	196	87·5%	37·0%		
			25.11.55	21.12.55	49	7	240	208	87·5%	53·5%		
Dieldrin 1% dust	5	20	18. 8.55	31. 8.55	41	—	86	358	—	19·4%	29·0% increase in 3·5 months approx.	2·5 months approx.
				28. 9.55	41	—	199	305	100·0%	39·5%		
				11.10.55	41	—	205	306	100%	40·5%		
				10.11.55	38	3	199	267	92·5%	42·7%		
			25.11.55	21.12.55	35	6	252	263	85·4%	48·4%		
Endrin 1·5% dust	5	25	19.10.55	9.11.55	60	—	66	203	—	21·8%	45·6% increase in 1 month approx.	2 months approx.
				21.12.55	60	—	516	180	100%	67·4%		
				7. 1.56	38	22	—	—	63·4%	—		
DDT 5% dust	5	25	19.10.55	9.11.55	59	—	118	323	—	26·8%	37·6% increase in 1 month approx.	2 months approx.
				21.12.55	59	—	526	291	100%	64·4%		
				7. 1.55	54	5	—	—	91·5%	—		
Untreated Check	5	25	—	14. 9.55	49	—	85	412	—	17·2%	4·4% decrease in 3 months approx.	Attack continued
				11.10.55	27	22	53	447	55·2%	10·6%		
				10.11.55	22	27	54	409	44·9%	12·0%		
				21.12.55	17	32	78	555	34·7%	12·8%		

data obtained in those studies. The 0.65 per cent. and 1.3 per cent. BHC dust, 1 per cent. Dieldrin dust 1.5 per cent. Endrin dust and 5 per cent. DDT dust all gave satisfactory protection of the crop against *Helopeltis* attacks for periods of 2 to 2½ months. This period cannot be construed as a measure of the residual effectiveness of the insecticidal dusts but rather as the period required before an effective build-up of *Helopeltis* entering from the neighbouring cacao areas into the treated tracts could take place in the treated areas. As mentioned earlier the treated tracts were of the extent of 5 to 8-acre blocks each surrounded by untreated cacao areas. If a large-scale area control of the pest is undertaken it is very likely that the period of protection of the crop against effective reinfestation by *Helopeltis* would be very much longer. Observations, as listed in Table 2, on the condition of other pods clearly indicate an increase in the percentage of pods free from attack by *Helopeltis* after treatment with the insecticidal dusts tested. The untreated plot used as a check showed a progressive uninterrupted increase in attack by *Helopeltis* and a decrease in the percentage of pods free from attack by the pest. The decrease in the number of attacked pods as shown in Table 2 is due to the fact that while allowance was made for harvesting some of these were lost between examinations to attack by squirrels or premature shedding due to attack by *Phytophthora* or physiological causes. The general increase in number of pods was the result of setting of new pods. The spectacular increase in pods, free from *Helopeltis* attack in Endrin and DDT tested areas is the result of carrying out the test dusting treatments during a peak period of flowering and pod setting. No apparent adverse affect on the setting of cacao flowers as a consequence of the insecticidal treatments was observed during these studies. On the basis of the results of these studies, the following recommendations for the control of *Helopeltis* attack on cacao in Ceylon are made :—

The cacao crop should be examined at least at fortnightly intervals after setting of pods commences. As soon as *Helopeltis* bugs and damage by this pest to the pods are recognized early in the season, dust with either 5 per cent. DDT, 1.3 per cent. gamma BHC, 1.5 per cent. Endrin or 1 per cent. Dieldrin dusts using a power-driven duster of the type described and dusting at the rate of about 10 lbs. of dust per acre. DDT and BHC dusts are cheaper at present than the other two dusts mentioned. Ten to twelve days later the dusted areas should be examined and if the pest is present dusting should be repeated. This treatment will serve to control any bugs surviving the first treatment and also those nymphs which were within the eggs during the first dusting. Dust masks or respirators and goggles are recommended for use by those concerned with the dusting as a protection against the irritant effects of the dusts and to prevent inhalation. The crop should subsequently be inspected at monthly intervals and dusting repeated when *Helopeltis* reappears.

Wherever attack of stems and young flush is detected the treatment recommended is as described above. However, in this instance, immediate steps should be taken to rehabilitate the appropriate shade.

Summary and Conclusions

(1) An unidentified and unrecorded species of *Helopeltis* and not *Helopeltis antonii* is responsible for heavy damage to the cacao crop in this country.

(2) The pest damages the cacao crop by inducing feeding lesions on pods which results in the premature shedding of the pods, retardation in growth or malformation of older pods and attracts the cacao pod borer *Dichocrocis punctiferalis,* and on growing flush and stems which results in die-back of new growth which if it occurs season after season results in the death of cacao plants.

(3) The pest normally prefers shade when attacking the pods and predominantly feeds on pods but attacks the stems of cacao plants when the overhead shade is poor due to bad pruning or neglect.

(4) No highly efficient naturally occurring biological controlling agents against *Helopeltis sp.* have been observed in Ceylon but the red ant, *Oecophylla smaragdina,* when present on pods nursing species of mealy bugs acts as a deterrent to *Helopeltis* attack.

(5) DDT and Dieldrin, both as high volume and low volume sprays have proved effective in the control of *Helopeltis sp.,* but spray techniques are tedious and slow and require repetition at monthly intervals for the satisfactory protection of the crop.

(6) A light power-driven duster ideally suited for use on local cacao plantations was available, and low percentage dust formulations of the insecticides DDT, gamma BHC, Dieldrin, Aldrin and Endrin were tested to assess their effectiveness in (*a*) immediate control of existing *Helopeltis* populations, (*b*) the prolonged protection of the cacao crop from reinfestation by this pest, and (*c*) increasing the amount of undamaged crop at harvest.

(7) Aldrin 2½ per cent. dust gave poor control of the pest even when repeated 12 days after the first treatment. DDT 5 per cent., gamma BHC .65 per cent. and 1.3 per cent, Dieldrin 1 per cent., and Endrin 1.5 per cent. dusts all gave complete to near complete control of the pest when applied at the rate of 10 lb. per acre.

(8) All the insecticidal dusts tested except Aldrin gave protection from *Helopeltis* attack for periods of 2 to 2½ months after dusting. This period of protection might well be longer if large-scale area-control is undertaken.

(9) All treated areas showed increases in the numbers of pods free from *Helopeltis* attack for periods up to 3½ months after treatment whereas the untreated check area showed a progressive decrease in the number of pods free from *Helopeltis attack.*

(10) No apparent effect on the pollination of cacao flowers as a consequence of insecticidal treatments was observed.

(11) Recommendations for the control of *Helopeltis* on cacao are made on the basis of these studies.

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Seed Infection and Seedling Blight of Paddy in the Dry Zone

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The two most important diseases of paddy in Ceylon and also in other rice growing countries are Paddy "Blast" caused by the fungus *Piricularia oryzae* and "Brown spot" or "Helminthosporiose" caused by the fungus *Helminthosporium oryzae*. The *Piricularia* disease has been really the more important of the two for a long time in Ceylon, but during recent years *Helminthosporium oryzae* has assumed increasing importance especially in the dry zones of the Island. *Helminthosporium oryzae* may occur on any part of the rice plant at any time during its entire life. Thus, germinating seedlings may be attacked causing the phase known as seedling blight. Ocfemia (1924) found the mortality amongst seedlings in the Philippines to vary from 10 to 58 per cent. while Tucker 1923 recorded 15 per cent. kill of seedlings in Puerto Rico. The second phase of the disease is the appearance of spots on the leaves. Sometimes the intensity of spotting may be such as to reduce the effective leaf surface, causing a marked weakening of plants, and the foliage may present a scorched appearance. The most important phase is when the inflorescence and the earheads are attacked, causing spotting in various degrees and reduction of the crop. Normally the damage caused is not very serious but under favourable conditions for the disease wide-spread epiphytotics may result in considerable losses.

Paddy Disease Survey

During the course of the year a survey of paddy samples from various parts of the dry zone was carried out to determine the amount of seed infection present with special reference to *Helminthosporium oryzae*. Representative random samples of seed paddy harvested from the *maha* 1953-54 crop were drawn, taking care, where large stocks are involved, to derive the final sample from a mixture of the contents of 20-25 bags.

Visual methods of separation of a sample into spotted, discoloured or healthy grains, which was first attempted, was found to give only a very rough assessment of the amount of seed infection in a sample, as even apparently healthy seed may contain infection. For infection rating therefore another technique was used. This consists of surface sterilizing the seed in mercuric chloride, washing in sterile water and plating a random 100 seeds on sterilized dextrose agar plates. The plates were incubated for 7 days at room temperature and the number of seeds yielding fungal growth was recorded. Not only is an accurate assessment of the infection rating thus

Table 1.—Paddy Disease Survey—Maha 1953–54

Station	Variety of Paddy	Percentage of Infection				
		Helminthosporium	*Curvularia*	*Trichoconis*	*Fusarium*	*Mucor*	*Penicillium*
Anuradhapura	V. I.	12	2	—	—	—	—
	H. M. C. 20	14	1	—	6	2	—
Bathmedilla	V. I.	2	5	7	—	—	—
	Dickwi	4	10	—	—	—	—
Hingurakgoda	V. I.	32	6	—	—	—	—
	H. M. C. 20	26	8	—	—	—	—
	Mas	24	4	—	—	—	—
	P. T. B. 16	46	—	—	—	—	—
	Murungakayan	12	—	—	—	4	—
Horana	Hondarawal	—	—	5	—	4	—
	Dickwi	49	8	—	—	—	—
Karadian Aru	V. I. S 2	30	—	—	—	—	—
	V. I.	36	1	—	—	—	2
	Perillanel	27	—	—	—	—	—
	Uvar Vellai	63	—	—	5	—	—
	Murungakayan	24	—	—	—	—	—
Kilinochchi	V. I.	3	1	—	—	—	—
Maha Illuppallama	P. P.	48	4	—	—	14	—
	V. I.	14	20	—	—	6	4
	V. I. (Range)	34	14	—	—	2	4
	Heenati	12	3	15	—	—	3
	H. M. C. 12—S 4	2	1	—	9	—	—
	Sulai	19	—	—	—	3	—
	H. M. C. 20	12	3	—	—	—	—
	V. I. (S 4)	18	1	—	6	3	—
	V. I. (S 3)	5	—	7	—	—	—
Minneriya	H. M. C. 20	20	—	—	—	8	2
Murunkan	V. I.	14	3	—	—	—	2
Nalanda	P. P.	—	—	—	14	12	4
	Molagusamba	6	—	—	12	—	4
	Mas	10	3	16	—	—	—
Nikaweratiya	V. I. (Wet)	6	—	—	—	5	—
	V. I.	26	3	—	—	6	—
	Murungakayan	11	4	4	—	4	—
Okkampitiya	V. I.—S. A.	6	5	—	—	—	—
	V. I.—S. B.	3	4	—	—	—	—
Paranthan	V. I. S 1. Bl. A	17	—	—	—	—	—
	V. I. S 2. Bl. B	12	—	—	10	16	—
	V. I. S. 3. Bl. C	14	—	—	8	14	—
	V. I. S 4. Bl. D	28	—	4	—	12	—
	V. I.	16	2	—	—	—	—
	S. R. 26B	—	2	—	—	—	—
	Periya Vellai	26	2	—	—	—	—
	S. R. 26	—	3	—	—	—	—
Polonnaruwa	P. P.	55	8	—	6	—	—
	Podiwi A 8	—	4	—	8	—	—
	P. T. B. 16	14	10	—	—	—	—
	Molagusamba	28	2	—	—	10	—
	Kohumawi	5	2	—	6	—	—
	H. M. C. 20	16	5	—	4	—	—
	Kurulutuduwi	6	—	—	3	—	—
	V. I.	24	2	9	—	10	—
Tabbowa	V. I.	3	9	36	—	—	—
	Dickwi	—	—	21	—	2	—
Unichchai	Oddavalan	38	4	—	—	—	—
	V. I.	33	—	—	4	—	—
Vakaneri	V. I.	22	2	—	—	—	—
Vavuniya	V. I.	14	2	—	—	—	—
	V. I. Highland	5	6	12	—	—	—

possible, but the actual fungi themselves could be identified by this method. Table I gives the results of the examination of 59 samples of paddy comprising of various varieties collected from different localities.

It would be seen that the percentage numbers denote the amount of internal seed infection of the samples as any surface infection would have been controlled by the effects of mercuric chloride. The fungi that are most commonly associated with the material examined were *Helminthosporium oryzae, Curvularia lunata, Trichoconis* sp. and the saprophytes *Murcor, Fusarium* and *Penicillium* sp. *Curuvularia* and *Trichoconis* could be considered weak parasites and have not been of any economic importance so far in our paddies. *Helminthosporium oryzae* is most consistently associated with the samples, the percentage of infection varying from 0—63 per cent. A point of some significance is that none of the localities from which the samples were collected were completely free from *Helminthosporium*. It is also interesting that none of the samples tested yielded *Piricularia oryzae* although *Piricularia oryzae* occurs sporadically in these areas. Certain workers Aoki (1937), Hemmi *et al.* (1937) and Anderson *et al.* (1947) have observed indications of an antagonism between *Piricularia oryzae* and *Helminthosporium oryzae* and it may well be that even if *Piricularia oryzae* were present in the samples it was unable to express itself in the presence of *Helminthosporium oryzae*.

Seed Disinfection

The question of disinfecting paddy seed infected by *Helminthosporium oryzae* has engaged the attention of numerous workers in the past. The results have been rather conflicting. For example Nisikado and Miyake (1922) claimed that dressing with mercuric choride, silver nitrate, copper sulphate, formaldehyde, &c., gave partial or entire control. Maung Thet Su (1932) found formalin, copper sulphate, sulphur, ceresan and hot water treatment gave no control at all. On the other hand Bugnicourt (1934) found treatment with formaldehyde effective and Cralley and Tullis (1937) using formaldehyde, organo-mercurials and red copper oxide got control only with the organo-mercurials. Reyes (1939) and Ocfemia (1924) found disinfection by chemicals ineffective.

It would be noted that inasmuch as infection can occur within the glumes of the grain, most fungicides like copper derivatives which will disinfect any fungus or spores that are found outside the seed will not exert much influence on the infection within the seed. The organo-mercurials which are volatile, however, are at an advantage in this regard inasmuch as they can exert a fumigant effect which could reach to some extent the fungus within the glumes. A number of laboratory experiments have been carried out to evaluate the efficacy of various available seed dressings on the control of seed-borne infection. In all cases seed naturally infected with *Helminthosporium oryzae* was used. The samples were treated with the various liquid or dry fungicides at the recommended rates and stored for a week. They were then put under pressure and the germinating seedlings were planted out in replicated glass dishes containing paddy soil. The seed dressings used were cupric oxide, cuprous oxide, copper carbonate,

Table II—Effect of Various Fungicides on the Control of Seedling Blight of Infected Paddy

Fungicide	*Active ingredient*	*Test 1*	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Test 6*	*Text 7*
		Vellai-illankalayan	*VI*	*VI*	*Pachchai-perumal*	*HMC20*	*Pachchai-perumal*	*Odda-valan*
		Percentage of Healthy Seedings						
Ceresan	Organo-mercurial	58·4	53·2	54·0	38·0	47·3	38·6	73·3
Agrosan	Organo-mercurial	59·6	53·6	36·0	54·6	59·3	56·0	84·3
Tillex liquid	Organo-mercurial	66·0	62·8	44·6	72·0	58·6	62·0	80·6
Tillex dust	Organo-mercurial	52·0	48·0	25·3	62·0	44·0	38·6	—
Copper lime	Copper carbonate	44·4	42·0	—	—	—	—	—
Fernasan	Thiram	—	—	26·6	16·0	38·0	23·3	—
Shell copper	Copper oxychloride	—	—	—	—	—	—	—
Cupravit	Copper oxychloride	—	—	—	—	—	—	—
Perenox	Cuprous oxide	50·8	46·8	44·0	48·0	36·6	30·0	—
Yellow cuprocide	Cupric oxide	—	—	—	—	—	—	47·3
Control	—	38·0	30·0	14·6	18·0	29·3	21·3	58·6

copper oxychloride, thiram and organo-mercurials Ceresan, Agrosan and Tillex. Untreated controls were kept as checks. The basins were placed near an open window in the laboratory. As the seedlings grow out the fungus also emerges causing varying proportions of seedling mortality in the various treatments. Table II summarizes the results of a number of such experiments giving the various percentages of healthy survivors that remained after three weeks from planting. The fungus growing at the collar of diseased seedlings was observed to be in the main *Helminthosporium oryzae*. The percentage of germination was not materially altered by any of the fungicidal treatments. The table shows that a rather high mortality of seedlings could be expected under the conditions of the experiment which obviously were conducive for attack by the fungus. The following conclusions could therefore be drawn :—

(1) Infected seedlings contained a high potentiality for seedling blight.

(2) The organo-mercurial fungicides have been more effective than copper or thiram fungicides in controlling this potential infection.

(3) Even with organo-mercurials, although a high degree of disinfection was obtained, 100 per cent. efficiency was not obtained.

Padmanabhan and others (1948) have shown that spotted seed is slightly lower in weight when compared to healthy seed. Inasmuch as the method of seed disinfection employed in the Japanese method of paddy cultivation incorporates prior to disinfection with copper fungicides, the immersion in a salt solution of S. G. 1.13 to separate out healthy seed, this method was explored to find out the extent of possibility of eliminating the infected seed from a seed sample. Three infected varieties *Pachchaiperumal, Vellai Illankalayan* and *Murungakayan* were treated with the salt solution method and the chemical method using Ceresan, keeping also untreated controls. The lots were grown

Table III.—Effect of Salt and Chemical Treatment on Infected Seed

Variety	*Murungakayan 32 per cent.* H.oryzae	*Vellai Illankalayan 32 per cent.* H.oryzae	*Pachchaiperumal 55 per cent.* H.oryzae
Control	30·6 ± 9·2 ..	18·6 ± 1·1 ..	24·6 ± 5·2
Salt treatment	24.6 ± 6.4 ..	22.6 ± 6.1 ..	12.0 ± 4.0
Ceresan	5.3 ± 3.8 ..	10.6 ± 3.5 ..	8.0 ± 2.0

in basins containing soil, in three replications. The seedling mortality per 100 seeds is shown in Table III.

It is evident that adequate separation of infected seed is not possible with the salt solution S.G. 1.13 alone. The organo-mercurial Ceresan gave the best control. In the Japanese method of seed treatment the salt water treatment is followed by treatment with a copper fungicide (Perenox) which controls a certain proportion of infection. Inasmuch as copper fungicides have been shown to be less effective than organo-mercurials in this respect it would be more advantageous to use the organo-mercurials in preference to the copper fungicides, using the precautions in handling that are prescribed in the use of organo-mercurials.

Field Trials

Field trials using seed treated with Ceresan, Yellow cuprocide, Agrosan and Tillex as against untreated controls have been characterized by two important features : (1) compared with the potential infection in the seed used there is an overall low infection rate in the seedlings in the various treatments and controls ; (2) there was no measurable difference in the seedling infection between the treatments and the untreated controls. Table IV summarizes the percentage of infected seedlings obtained in these trials.

It is clear that in the field a high seed infection has not brought about the high seedling infection observed in laboratory experiments.

Table IV - Percentage of Infected Seedlings in Field Trials on Control of Seedling Infection

Locality	*Season*	*Variety*		*Control*	*Agrosan*	*Fernasan*	*Ceresan*	*Tillex*	*Yellow cuprocide*
Hingurakgoda ..	Yala 1954 ..	Wanni Dahanala 44 per cent.	Wet sowing ..	1·06 ..	1·49 ..	— ..	1·53 ..	1·14 ..	1·11
Karadian Aru ..	Yala 1954 ..	Oddavalan 38 per cent.	,, ..	3 ..	1·8 ..	— ..	1·2 ..	1·4 ..	2·4
	Maha 53/54 ..	Vellai Perenal ..	Dry sowing ..	9·68 ..	7·9 ..	8·16 ..	— ..	3·92 ..	4·72

Greenhouse Trials

Inasmuch as under field conditions accurate measurement of seed mortality presents considerable difficulties, other experiments were carried out to check the negative results obtained in the field. Infected seed containing 38 per cent. *Helminthosporium* was treated with various fungicides and planted out in basins in soil. One set of replicates was maintained under laboratory conditions while another set was placed in the open in the greenhouse and the seedling infection recorded. The results obtained are shown in Table V.

These further confirm the results obtained in the field trials that seedling blight is reduced in paddy grown in the open in comparison with the laboratory trials.

Discussion

Ocfemia (1924a) has shown an interesting relation between the development of the disease and soil temperature. Although the optimum temperature for the growth of the fungus is 28°C. he has demonstrated that the maximum mortality occurs between 16-24°C. when the seeds emerge slowly. Indeed 100 per cent. mortality could occur at 16°C. At 28°C. mortality is greatly reduced while raising the temperature still further to 36°C. results in negligible loss. The quality of the seed (as regards infection) affects the germination at soil temperatures from 16-24°C. Thomas in India has found a similar result. Padmanabhan and others (1949) also report that when they sowed seed infected to varying proportions no significant differences were observed as regards seedling

TABLE V

Variety of Paddy	*Treatment*	*Dosage*	*Estimation of internal contamination per cent. by plating*	*Germination*		*Seedling Blight*	
				Lab.	*Plant House*	*Laboratory Temp. 24.5-27.5°C.*	*Green House Temp. 25-32.5°C*
Oddavalan ..			.. 38 per cent. H				
	Perenox	4 oz/10 gallons	..	90·6	88·0	18·6	2·6
	Shell Copper	4 oz/10 gallons	..	90·0	90·0	26·0	3·3
	Cupravit	4 oz/10 gallons	..	88·0	89·3	26·0	3·3
	Ceresan Wet	1 oz/1gallon/1 cwt.	..	81·3	77·3	25·3	1·3
	Control	—	..	83·3	86·6	31·3	5·3
Vellai Illankalayan ..			.. 63 per cent. H				
	Ceresan Wet	1 oz/1 gallon/1 cwt.	..	86·0	84·8	17·2	0·6
	Perenox	4 oz/10 gallons	..	68·0	59·2	19·2	1·6
	Control	—	..	63·6	66·4	32·0	6·8
Vellai Perenel..			.. 28 per cent. H				
	Agrosan	4 oz/1 cwt.	..	93·0	93·5	17·0	1·0
	Ceresan Wet	1 oz/1 gallon/1cwt.	..	91·0	88·5	22·5	3·0
	Perenox	4 oz/10 gallons	..	87·0	87·5	25·0	4·5
	Control	—	..	89·0	88·0	25·0	8·5

blight when compared with healthy seed. They conclude that the seedling blight phase is not likely to cause extensive damage in Bengal.

Temperature records for Hingurakgoda show that the maximum air temperature in the shade is above 32.5°C. up to about the middle of October when it starts dropping below this figure. The soil temperature in the open fields is however unavailable but could be expected to be even higher. It would therefore be reasonable to conclude that the depression of the seedling blight phase of the disease is due to the high soil temperatures obtained during germination. The position is that although dry zone seed is known to contain a high potential for causing seedling blight, when grown under normal field conditions with a high soil temperature of over 28°C. the seedling blight phase is reduced. This phase of the disease caused by *Helminthosporium* has so far been of no importance in the dry zone.

The reduction in seedling blight at temperatures above 28°C. is ascribed by Ocfemia to the rapid growth of the seedlings at this temperature which enables them to outgrow the fungus. There is no indication, however, that the fungus is killed. It is therefore reasonable to infer that any condition which helps the quick and vigorous growth of the plant would help the seedlings to outgrow the fungus. Under conditions which are far from ideal for seedling growth the fungus can be expected to assert itself. It may be possible on this assumption to explain the observation made last *maha* that infected seed gave severely attacked plants when grown on newly cleared highland but when grown under normal mud-sown conditions resulted in much milder infection.

Either with seed dressings or without it is evident that a small proportion of seedlings do give rise to primary infection which under suitable climatic conditions of intermittant rains as obtaining in *maha* at Hingurakgoda may be able to build up to an epiphytotic. The ideal should therefore be to use clean seed as far as possible or at the most seed of low infection rating, disinfected with an organo-mercuric fungicide.

It may also be pointed out that although seed dressing does not appear to have any advantage over the untreated paddy in the control of seedling blight under the favourable conditions of temperature, where a stock of paddy is distributed for growing under widely differing conditions, seed dressings are a necessary insurance against seedling blight. There are indications that when severe epiphytotics of *Helminthosporium* occur in the dry zone it is generally at the flowering stage of the paddy plants. Control of this secondary infection has really to be approached from the angle of ameliorating soil conditions and selection of resistant varieties.

Summary

1. A survey of paddy seed stocks in the dry zone has shown a high incidence of infection with *Helminthosporium oryzae*.

2. In laboratory experiments organomercurials have shown considerable efficiency in controlling this seed infection from causing seedling blight.

3. In the field, however, in spite of the high infection in the seed, seedling blight phase of the disease is relatively low.

4. The high soil temperature of over 28°C. obtaining in the dry zone is shown to play an important part in suppressing the seedling blight phase of the disease.

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Studies on the Improved Methods of Production, Storage and Standardization of Papain

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Papain is the latex obtained from the green mature papaw fruit. In four earlier publications is described the work carried out in Ceylon, relating to this product, (1), (2), (3), (4).

Papain is a complex mixture of proteolytic enzymes and peroxidases. Two different proteolytic enzymes have been isolated and have been named papain and chymopapain, (5), (6). Papain undergoes oxidation and coagulates rapidly on stirring, with a fall in *p*H from 6.2 to 5.8. The latex shows no signs of deterioration for about 4 hours after extraction from the fruit, at 25 to 30°C. Decomposition sets in gradually and the product develops an offensive smell after about 24 hours, with a rise in *p*H to 7.2. In view of the unstable nature of papain, the product should be collected as quickly as possible and dried without delay in a well ventilated drier.

Dried papain is exported from Ceylon to Europe, America and other countries where it is used for pharmaceutical and industrial purposes. It is used extensively in the preparation of digestive tablets and elixirs, in the preparation of peptonised foods, in the softening of meat, in the clarification of beer, in the manufacture of chewing gum, in the softening of hides, in the improvement of the handle of wool, and in the degumming of silk.

Drying and Storage of Papain

Experiments on the drying of papain have shown that at temperatures above 55°C. the product tends to lose part of its activity. At temperatures above 70°C. its activity is almost completely lost. It was also found that papain dried to a moisture content below 8 per cent. had the best keeping quality. Quick drying was necessary to prevent losses in activity. A drier was designed to effect rapid drying at 55°C. A plan of the drier is shown in Diagram 1.

Well dried papain is creamy white in colour and should be packed without delay in rust-proof tins. The air in the tins is partly removed by means of a hand-operated suction pump and the tin is sealed airtight. The product preserved in this manner was found to keep without loss in activity for about 6 months.

Standardization of Papain

High quality commercial papain is crisp and creamy white in colour and below 8 per cent. in moisture. It generally has an ash content ranging from about 10 to 12 per cent. as shown in Table I, and a nitrogen content of 11.5 to 11.8 per cent. on a moisture-free basis. Commercial papain of high quality has an activity above 80 per cent. of a laboratory dried sample of latex

Table I

Source of Genuine Papain	*Percentage Ash on Moisture-free Basis*
Henegederalanda ..	11·16
Do.	11·27
Do.	10·87
Do.	11·39
Do.	11·18
Do.	11·34
Do.	11·18
Do.	11·48
Do.	11·41
Palliyadda	12·05
Do.	10·90
Omeragolla	11·15
Do.	10·41
Ambanpola	11·60
Do.	11·43
Do.	11·48
Do.	11·35
Do.	11·34
Do.	11·39
Galewela	9·84
Kanadana	8·15
Do.	10·03
Hombawa	10·94
Pallebedde	11·85
Do.	10·35
Do.	10·31
Godakawela	10·60
Do.	9·61
Thimbulketiya ..	10·25
Embilipitiya ..	8·30
Do.	7·53
Koswetiya	9·31
Do.	10·13

obtained from the same area. Papain discolours on storage with loss in activity and the destruction of the peroxidase enzymes. A simple test has been worked out to roughly assess the age of the product from its peroxidase content. The test is carried out as follows :—

One tenth of a gramme of the papain is dissolved in 10 c.c. of water. To 5 c.c. of this solution are added 3 c.c. of a 0.5 per cent. solution of guaiacol in 50 per cent. ethyl alcohol and 3 c.c. of a 0.5 per cent. solution of benzidine in 95 per cent. ethyl alcohol and 3 c.c. of a 0.3 per cent. solution of hydrogen peroxide. An intense pink colour is produced in the case of a fresh sample of high quality commercial papain of not more than about six months under storage. In the case of poor quality samples which have deteriorated under storage for over one or two years, no instantaneous pink colour is formed. A faint pink colour may develop only after a few minutes.

It was found that papain begins to show signs of decomposition with the liberation of strong smelling volatile products, accompanied by a rapid change in colour to brown, at temperatures above 100°C. It is therefore advisable not to raise the temperature above 100°C. in estimating moisture in papain. It is important that the ash content of papain should be determined by ashing it at temperatures not above 550° to 600°C. as at higher temperatures there is a tendency for certain volatile mineral constitutents of the ash to be lost.

In the case of foreign substances that may be admixed with the papain, it was found that starch or flour could be easily detected by the dark blue colour formed on the addition of an excess of tincture of iodine to a solution of the product, in hot water. Care should be taken to add a large excess of iodine, as papain itself first reacts with the iodine and then the excess iodine would react with the starch.

Papain gives a cloudy solution when dissolved in hot water. Any insoluble substances like coconut refuse or poonac or papaw pulp can be detected by filtering the solution through filter paper. The insoluble matter remaining in the filter paper can be examined microscopically, to identify foreign substances.

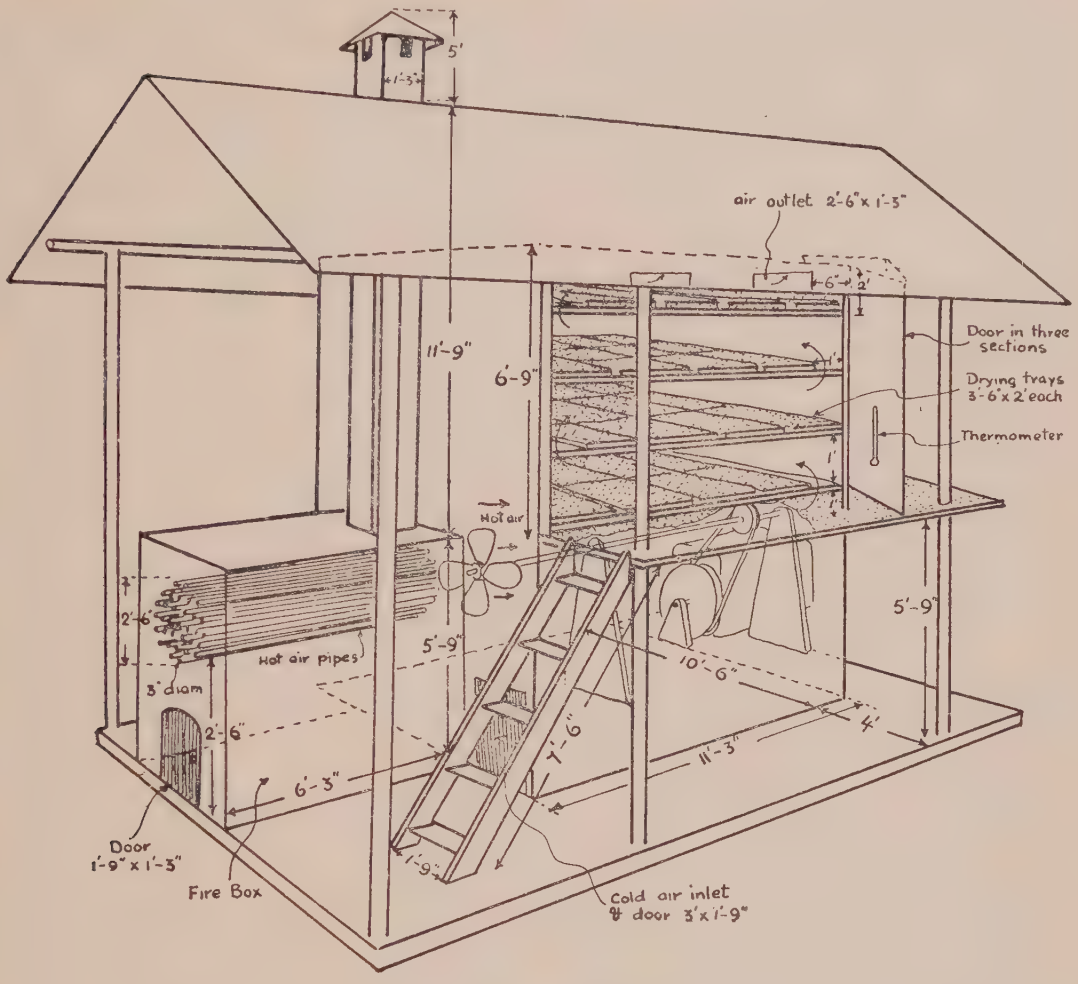

Diagram 1—Papain Drier

Cashew gum and other pentose producing gums used as adulterants can be detected by the phloroglucinol test worked out by Joachim with papain in 1935 (7) which is carried out as follows :—

A solution of the papain is made in hot water by dissolving one part of papain in 10 parts by weight of water. The solution is filtered and to the filtrate is added an equal volume of a solution of phloroglucinol prepared by dissolving one gramme of this reagent in 100 c.c. of concentrated hydrochloric acid. A test tube containing the mixed solutions is placed in boiling water. In the case of pure papain, the solution turns yellow in colour in a few minutes, while in the presence of Cashew gum or pentose-gums, the solution turns a cherry-red followed by the formation of a reddish-brown precipitate.

Pure papain contains 11.5 to 11.8 per cent. of nitrogen on a moisture-free basis. If the nitrogen content of a sample is determined by analysis, and it is found to be far below 11.5 per cent. or far above 11.8 per cent., then the presence of adulterants is indicated.

The proteolytic activity of papain is the chief criterion of its quality, and papain is priced in the trade on its proteolytic activity. A number of methods of estimating the activity of papain was investigated, namely, the gelatine viscosity method, the casein digestion method, the milk clotting method and the beef digestion method. It was found that the beef digestion method was the most feasible for purposes of standardizing laboratory-dried reference samples of papain and using these samples for comparison with commercial samples. The method worked out for estimating the activity of papain is based on the American National Formulary method, (8).

In the National Formulary method, the difference in the volumes of residual beef between a blank control without papain and the digest containing papain is assumed to be a measure of the amount of digestion which is a measure of the activity of papain. Hence, commercial samples can be compared against standard reference samples of papain. This method is suitable for rough comparison against a reference sample. For more accurate work, the National Formulary method was modified and the digested beef was estimated gravimetrically after filtration. A linear relationship giving a straight line graph was obtained when the amounts of beef digested were plotted against the logarithms of the

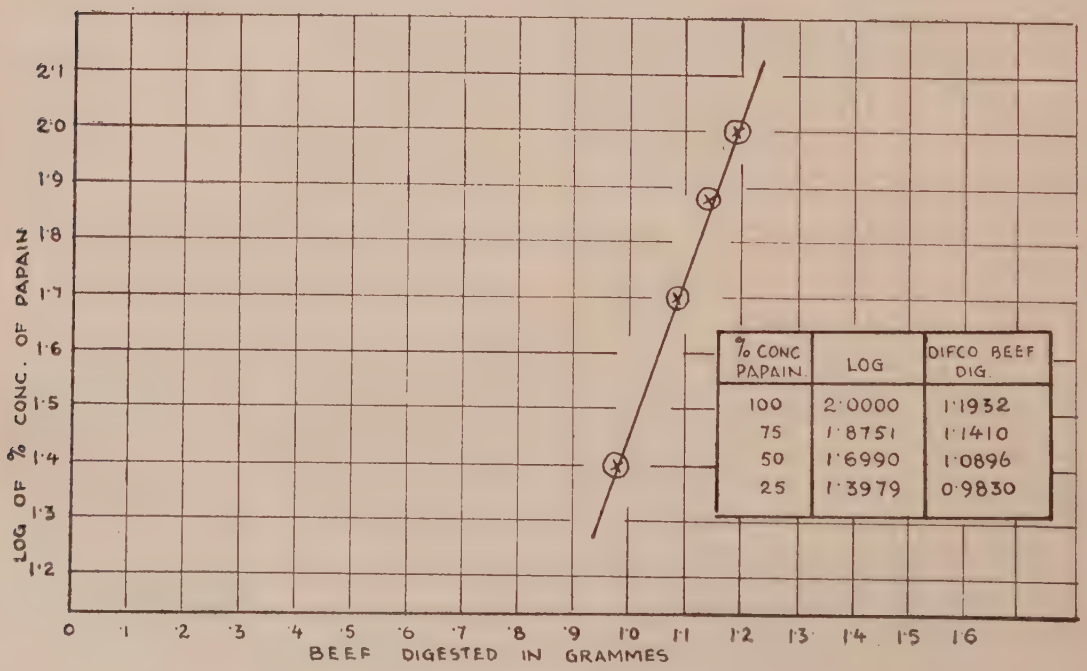

Figure 1

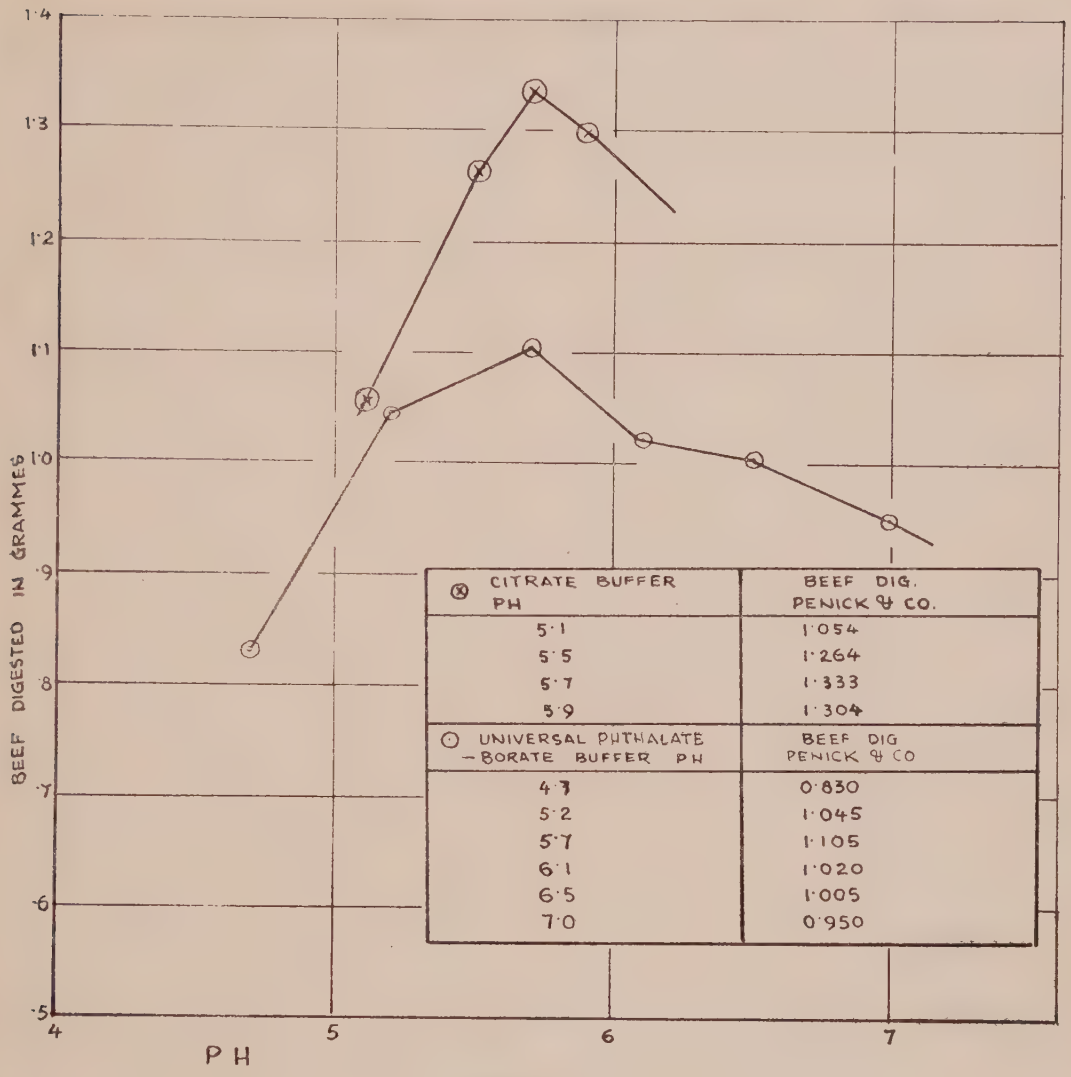

Figure 2

concentrations of papain used. The graph in Figure 1 shows this relationship which has also been reported by other workers, (9).

It was found that the *p*H was maintained within reasonable limits by the buffering action of the products of digestion when distilled water was used in the medium. The *p*H changed from 4.8 before digestion to 5.1 after digestion. The *p*H measurements were taken with a glass electrode system. If the *p*H of the substrate was changed by using various standard buffers, it was found that maximum digestion was obtained at a *p*H of 5.7. But, the maximum amount digested depended on the type of buffer used, as reported by others as well, (10). This is evident from the graphs obtained in Figure 2 where

citirate buffers and universal phthalate —borate buffers were used. These graphs shows curves with maximum digestions at *p*H 5.7. The variation in the amounts of beef digested is least in the *p*H range 5.6 to 5.8 and is permissible for a reaction of this nature. Hence, the precision in the assay of digestibility is highest in this range of *p*H. This is substantiated by the experiment where digestions were carried out using distilled water in the substrate in one instance (A), and a buffered substrate at *p*H 5.7 using 0.05 M sodium citrate in the other (B). The two straight lines (A) and (B) obtained, as shown in Figure 3, indicate that (B) gives a more reliable relationship than (A) between amounts of beef digested and the logarithms of the concentrations of papain used. The amounts of beef digested by a two-year old sample of papain were interpolated on these straight lines and it was found that the line (B) gave an activity of 42.6 per cent. while the line (A) gave an activity of 63.1 per cent. As a two-year old sample cannot have a high activity, 42.6 per cent. is a more reliable result than 63.1 per cent. The method of assay was therefore modified on the above lines and is carried out as follows :—

Two grammes of lean beef powder free from fat and fibrous tissue are placed in a 150 c.c. flask. To this is added 0.1 gramme of a well ground sample of papain. 50 c.c. of a 0.05 M sodium citrate buffer at *p*H 6 are added and the flask is rotated to bring about admixture. The *p*H then becomes steady at 5.7. Another similar flask containing 2 grammes of the same beef powder and 50 c.c. of the same buffer is prepared without the addition of papain. This is the blank control. Both flasks are closed with a loosely fitting rubber stopper and incubated at 52°c. for 2 hours. The flasks are carefully rotated once every 15 minutes during the two hours. At the end of the two hours, the contents of the flasks are poured separately into two dried and tared filter papers, number 541 of 15 cm. diameter. The particles of beef in the flasks are washed down into the respective filter papers with distilled water, by means of a glass rod with a rubber policeman attached to it. The undigested beef in the filter paper was dried in an oven at 100°C. with the filter paper and weighed. The difference in weight between this and the filter paper gives the weight of undigested beef. The same procedure is followed with the blank control sample. Then the difference in weight between the two weights of beef left, gives the weight of beef actually digested by the papain.

In the case of an unknown commercial sample of papain, the amount of beef digested by 0.1 gramme of this sample is compared with the amounts digested by 0.1, 0.075, 0.050, 0.025, and 0.010 gramme respectively, of the standard laboratory dried reference sample. The digestions of the unknown and the reference samples are carried out at the same time with the blank control, to ensure the same conditions. A graph is plotted with the amounts of beef digested against the logarithms of the concentrations of reference papain used, the concentrations being expressed as percentages. Hence 0.1, 0.075, 0.050, 0.025 and 0.010 will become 100, 75, 50, 25 and 10 respectively, and the logarithms of the latter percentages are taken. This will give a straight line. The percentage activity of the unknown commercial sample in relation to the reference papain can then be read off

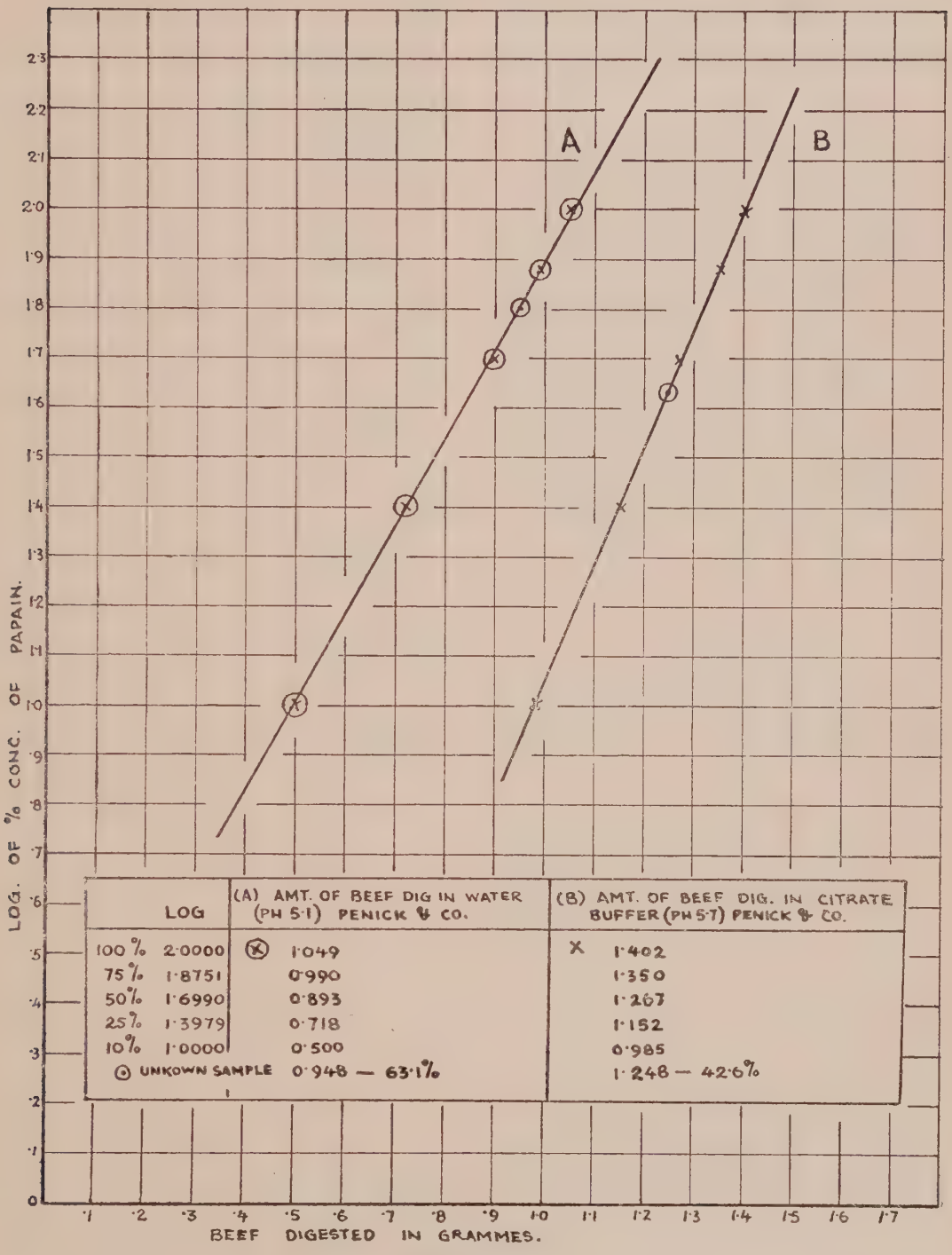
A
B
LOG. OF % CONC. OF PAPAIN.
BEEF DIGESTED IN GRAMMES.
LOG
(A) AMT. OF BEEF DIG IN WATER (PH 5·1) PENICK & CO.
(B) AMT. OF BEEF DIG. IN CITRATE BUFFER (PH 5·7) PENICK & CO.
100 % 2·0000 ⊗ 1·049 × 1·402
75 % 1·8751 0·990 1·350
50 % 1·6990 0·893 1·267
25 % 1·3979 0·718 1·152
10 % 1·0000 0·500 0·985
⊙ UNKOWN SAMPLE 0·948 — 63·1% 1·248 — 42·6%

Figure 3

from the straight line, against the figure obtained for the beef digested by the unknown sample.

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Implemental and Mechanized Methods of Rice Production in Ceylon

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The staple diet of the Ceylonese is rice. In the past, rice production in Ceylon was regarded as not worthwhile because of the low yields usually obtained and the low prices that persisted due to the availability of ample supplies of cheap rice from Burma. With the introduction of a State Guaranteed Price of Rs. 12 per bushel, the production of rice has been stimulated to a great extent. At present Ceylon imports nearly 439,000 tons of rice at a cost of about 325 million rupees. Efforts are now being made to lessen the dependence on supplies from abroad.

The present extent under rice in Ceylon is just over a million acres. The average size of a holding is about ¾ acre. In some cases, a single piece of land is owned by more than one owner. The smallest units of rice land holdings are in the Kandyan districts. On the other hand, in the Batticaloa district, holdings of ten acres or more in extent are common. The existence of small holdings which are totally uneconomic in size is due to the fragmentation of land aided by the laws of inheritance.

Climate and Soils

Climatically, Ceylon is divided into a wet zone and a dry zone. The wet zone has a satisfactory rainfall both in amount and distribution and favourable temperature and humidity conditions. It represents about one quarter of the land area of the Island, and of this, the low lying areas comprising about 250,000 acres are cultivated with rice. The dry zone extends over three-quarters of the Island and is climatically less favoured than the wet zone. The amounts, effectiveness, and distribution of rainfall in this region vary considerably according to the particular area and are very often unreliable and unpredictable.

Soils vary from light to heavy in texture and range from good to poor according to topography, locality, husbandry, &c. In the wet zone water conservation is less important than drainage for improving the physical, chemical and biological conditions. In the dry zone, however, soil and water conservation practices are of great importance. In the dry zone, large underground water supplies for irrigation purposes are not found due to the presence of a flooring of crystalline rock over the greater portion of the area. However, there are exceptions in the north-western coast and in the Jaffna Peninsula, where the nature of the underground limestone rock permits the accumulation of water. This means that in the absence of sufficient surface or underground water supplies, rice production in the dry zone calls for the provision of water.

Production and Irrigation Methods and Labour Requirements

Rice production is carried out under :—

(*a*) Human power only,

(*b*) Animal power and human power,

(*c*) Tractor power and human power,

(*d*) Tractor power, animal power and human power,

(*e*) Tractor power only (to a very small extent).

In the wet zone, the crop is grown under rainfed conditions solely, or under rainfed and irrigated conditions. Channel irrigation is commonly practised, but in a few cases lift irrigation is also operative. In the dry zone, a highland rainfed crop is grown or the crop is channel irrigated with water from local storage tanks or from major tanks linked with rivers.

Lift irrigation is not very common at present. Water lifting devices used are the single mhote, double mhote, Persian wheel, well sweep, wind mill, wooden water scoop, wooden water wheel, palmyrah leaf bucket and imported engine-driven water pumps. The source of water, where the single mhote, double mhote, Persian wheel, well sweep and wind mill are used is very often a well. For engine-driven pumps, a perennial stream often provides the source of water.

A single mhote or a double mhote is worked by a pair of bulls and two men. Either device can lift up to about 1,400 gallons per hour and irrigate about an acre in six to eight hours. A Persian wheel can also be operated by two men with a pair of bulls and lift about 2,000 gallons per hour. It can irrigate over one acre in eight hours. A well sweep can normally lift about 1,300 gallons of water per hour and irrigate about one acre in eight hours. Five men are required to operate it—one man to irrigate, one to empty the bucket of water into the channel and three to walk up and down the well sweep. The wind mill, as its name suggests, is wind-operated. The amount of water lifted varies according to the velocity of the wind and the diameter of the assembly of the rotating blades. The output would be about 360 gallons per hour during periods of weak winds. The water scoop, water wheel and the palmyrah leaf bucket are used to lift water from waterlogged rice fields prior to sowing of seed in low lying areas where the level of the field is lower than that of the drainage channel. A water scoop can bale out 600 to 800 gallons per hour and about 64 man-hours are required to lift water from an acre. A water wheel can lift about 3,000 gallons of water per hour and at an average about 9 man-hours are used to lift water from one acre. A palmyrah leaf bucket can lift about 600 gallons per hour with two men operating it. Where engine-driven water pumps are used, the volume of water lifted per hour varies from about 40,000 gallons to 100,000 gallons depending on the power and size of the unit used.

When rice production is totally done by man power, it takes about 490 man hours inclusive of irrigation, watching and weeding to cultivate an acre. When animal power and human power are used for cultivation, about 160 animal-hours and 340 man-hours are used per acre. Using men, machines and animals, about 6 machine-hours, 80 animal-hours and 340 man-hours are required for an acre crop, if no mudding is done with animals after tractor

ploughing. Using man and machines only about 310 man-hours and 14 machine-hours are necessary. However, when hand-weeding is done and threshing and winnowing operations are mechanized, it may take as much as 452 man-hours and 20 machine-hours. Irrigation, hand-weeding and hand-harvesting, and transporting to threshing floor make up about 320 man-hours.

Timeliness of Operations

The timeliness of operations varies in the different locations where rice is grown. It is absolutely necessary to keep to time in growing the crop as delay affects yields adversely and at times results in complete failure of the crop. If it is too early, generally, the harvest encounters the rains and is damaged considerably. Very often, where operations are delayed and the crop is late in the season, uneven flowering and occurrence of pests and diseases may cause such heavy damage to the crop as not to warrant its harvest. In certain areas as water is issued for irrigation according to rules laid down by the Irrigation Department, the period of issue being decided on by the cultivators at a meeting with Government officials, any delay in carrying out the operations would be detrimental to the successful growth of the crop, as water is not issued off season. Such delay in the dry zone may, in the absence of rains, result in complete failure of the crop if it is two weeks or more late in the season.

In the different locations where rice is grown, the seasons are adjusted according to the incidence of the rainfall of the area or the availability of irrigation water, and the drought period which normally coincides with harvesting time. If operations are late, the requirement of labour per acre will also increase owing to the labour required to control pests and diseases.

If tractors are used for primary tillage, delay in cultivation may make conditions in the fields too wet for the use of tractors, and if cattle or labour are not available, it may become necessary to abandon cultivation during that particular season. In some areas, for instance in the Western and Southern Provinces, where rainfed crops are grown, heavy rains which cause floods and drought periods have to be avoided for primary tillage operations.

Progress and Problems of Mechanization

Although the first tractors used in Ceylon were as far back as 1920, it was only (sometime in 1942) during the second world war that motorised power was used for the first time for primary tillage in rice cultivation. The Agricultural Engineering Division of the Department of Agriculture demonstrated the economics of the use of tractors under proper management for primary tillage operations in rice cultivation by establishing six experimental tractor units at appropriate locations in the country. Following on the success of these economic trials, the demand for tractor cultivation increased rapidly especially in areas where there was a dearth of cattle and labour. The Government encouraged the use of tractors by giving loans to Co-operative Societies to purchase tractors and by establishing tractor units at various locations where a shortage of cattle and labour existed. The areas where mechanization is mostly carried out fall within a belt ranging from a section of

the Southern Province, the Eastern, Northern and North-Central Provinces, and a portion of the Central and North-Western Provinces. There are about 1,000 agricultural tractors in use in the country today. This figure includes the gift of nearly 200 tractors given by the Australian Government under the auspices of the Colombo Plan.

The tractor units run by the Government and C. A. P. & S. Societies undertake work for private parties at more or less standardized rates. In some cases, tractor units have been run at a loss due mainly to heavy repair bills, lack of adequate supervision and the poor quality of the operators used to man the machines. Heavy repair bills have been in some cases due to the damage caused to machinery used on areas newly developed by using human power. The presence of stumps and roots in such areas have caused considerable damage to machinery. This lays stress on the necessity to use machinery for efficient land development work if tillage operations are to be mechanized thereafter. The use of tractors with trailed implements in the small rice fields is cumbersome and not common in the country. Tractors with mounted implements where the tractor and the implement work as one integrated unit are quite popular now. The agricultural tractors used in Ceylon are of various makes and types and at the moment it is not possible to say which particular make or type is the most suitable for a particular locality or job. The common implements used for primary tillage are the mouldboard plough, disc plough, tine tiller, disc tiller and the tandem disc harrow. Seeding operations have not been mechanized so far except on some State Farms where seed drills are being tried out on an experimental scale. A few private farms and some State Farms use threshing and winnowing machinery, while harvesting, threshing and winnowing machinery like combines are still being tried out on an experimental scale. Due to the small size of checks in the rice fields of Ceylon, some imported machinery had to be adapted to suit local conditions. A study of seed drilling, intercultivating following seed drilling, and the introduction of suitable harvesting, threshing and winnowing machinery appears to be necessary for the successful mechanization of rice. The breeding of rice varieties resistant to lodging and which do not shatter easily is also necessary for the successful use of combines in Ceylon.

Primary Tillage Operations

Where human power only is used, the tools used for primary tillage are the mamoty and the hand leveller. Mamoties vary in size and shape, especially in the up country districts. Their shape may be rectangular, oval-crescent or conical. The common sizes are 10 in. × 8 in. for the imported variety and 10 in. × 10 in., 14 in. × 6½ in., 12 in. × 7½ in., 18 in. × 6 in. for locally made varieties. The locally made mamoties are solely used for rice cultivation under wet and soft conditions in the fields. The number of man-hours used per acre vary from 30 to 120 depending on the size of the mamoty, the skill of the labour, and the type of soil on which it is being worked. The hand leveller used for levelling is made of wood locally. It takes 5 to 16 man-hours per acre for final levelling. With animal power, mudding the fields by using buffaloes is done in some areas. Where this is not practised, a country

wooden plough which does not turn over the soil, or a light iron mouldboard plough or an imported mouldboard plough drawn by two head of cattle, is used. The imported ploughs are used only when suitable draught animals are available, as these ploughs are normally too heavy for the local breeds of cattle. The accomplishment of animal-drawn ploughs varies from 12 to 32 hours per acre. Very often these ploughs are used under wet and muddy conditions which only permit the use of animal-drawn implements. In a very few cases elephants are used to work either a tine tiller or a disc harrow for primary tillage.

After ploughing, a wooden tooth harrow, known as a Burmese harrow, is used for breaking the clods. In some areas a spike harrow, with iron tines 6 in. to 8 in. long and spaced 4 in. apart fixed on to a wooden plank, is used after ploughing. The accomplishment of each of these harrows is about 8 man-hours per acre. For levelling a board of width varying from 4½ ft. to 6½ ft. is used. About 4 man-hours are required for an acre after using the harrow. Normally two animals are used during each of the operations of ploughing, harrowing and levelling.

Where tractors are used for primary tillage operations, the tine tiller is the most popular. The mouldboard plough was tried out originally but due to the considerable wear on the shares its use is not so popular as the disc plough. In some cases the disc tiller is also used, and is more popular than the disc plough due to its greater output per hour and cheaper cost of working per acre. Rotovators and tandem disc harrows have also been used with some success. Mounted implements have become more popular than the trailed types as the small checks of the rice fields make the latter very cumbersome.

Seeding and Transplanting

Hand broadcasting of seed is very common in Ceylon. About 2-5 bushels of seed are required per acre. The labour required is about 3 man-hours per acre. The yields are generally low compared to transplanting which takes about ¾ bushels of seed per acre. Transplanted fields are less liable to lodge than broadcast fields and give more yields. The conventional method of transplanting is at a spacing of 4 in. to 8 in., but in the recently-introduced Japanese method the spacing is 10 in. to 12 in. between rows and 6 in. to 12 in. within the row. In the conventional method the rows are uneven and the use of hand tools for controlling weeds is not possible unlike in the Japanese method where rotary hand weeders are used effectively for controlling weeds between rows of plants. The labour requirements vary, depending on factors such as the type of soil and the efficiency of the labour used. On sandy soils more labour is required than on clay soils. The labour required varies from 64-160 man-hours per acre. In the wet zone labour is not so scarce for transplanting and it is a more common practice than in the dry zone. Either hired labour is used or co-operative planting is practised, but the increased cost of cultivation is greatly offset by the higher yields obtained, especially with the Japanese method where effective control of weeds is possible. When the Japanese method of transplanting is used the labour required has been high for transplanting and subsequent operations but the yields have been very good. In some

cases over 100 per cent. increase in yields have been recorded. Transplanting economises in labour due to the obviation of the necessity to level the fields carefully which is very necessary when broadcasting is adopted. However, transplanting is difficult in areas where the soils are sandy and where labour is scarce.

When tractor-drawn seed drills are used, drilling seed in rows 12 in. apart has been found to be the optimum spacing. However the popular method is to broadcast the seed by hand and to cover them with a light disc harrow or tine tiller.

Cultivation including Pest and Weed Control

When the Japanese method of transplanting is practised, imported Japanese rotary weeders are used for the effective control of weeds between the rows of plants. In broadcast fields hand weeding is done where labour is available, or a Burmese wooden harrow is used for harrowing the standing crop to control weeds. Tractor-drawn intercultivating equipment are not in use at the moment in rice cultivation.

When hand weeding is done, about 140 man-hours or more per acre are required. When the Burmese harrow is used 16 animal-hours and 8 man-hours are required per acre. A Japanese rotary weeder requires about 48 man-hours per acre. A rotary tractor-drawn weeder has been tried out with some success at the Research Station, Maha-Illuppallama. Pests are controlled by the use of chemical sprays or dusts. Very often a 2-gallon capacity Knapsack sprayer which does an acre in one man-hour or a 5 gallon capacity rotary hand duster which also requires one man-hour per acre, is used.

Harvesting, Threshing, Winnowing and Transporting

The usual method of harvesting is by the hand sickle. The labour requirements vary from about 80 to about 120 man-hours per acre.

Combines for harvesting, threshing and winnowing rice have been tried out on a small scale, but many difficulties were experienced in their use. The smallness of the size of checks of rice fields, the unfavourable conditions in the field at the time of harvesting in most areas, the unfavourable stand of the crop when plants lodge, and the easy shattering of seeds of most rice varieties are the main obstacles hindering the use of combines in Ceylon. However, the stationary threshing and winnowing of rice with combines in the absence of separate threshing and winnowing machinery has been tried out with some success. A few threshing and winnowing machines are being used with success in certain parts of the country. Threshing by running the tractor on sheaves of paddy is fairly common in areas where cattle are scarce.

When buffaloes are used for threshing, about 60 animal-hours and 24 man-hours are required for an acre crop. When threshing is done by foot, about 80 man-hours are required for an acre crop. When tractors are used about 1½ machine-hours and 32 man-hours are required for an acre crop. When combines or threshing machinery are used for stationary threshing and winnowing, about an acre crop or a little less could be threshed and winnowed in 5 man-hours and 1 machine-hour. The use of sticks for threshing is not quite common in Ceylon. It is practised rarely in the Eastern Province in Ceylon where a

farmer or a member of his family adopts this method to get a small quantity of rice for his consumption requirement by threshing a few sheaves from his stack or shocks of rice harvested and kept near his home. A hand winnower made locally out of cane is commonly used for winnowing rice by the use of atmospheric wind. In some cases especially on State Farms, winnowing machines worked by hand are used. A hand winnower does about 40 bushels in 8 man-hours if wind is used. A winnowing machine of the Chindwin type worked by hand normally does about 40 bushels in 6 man-hours.

In certain parts, a device made locally with a fan and parts of a bicycle and worked by hand is used successfully for winnowing rice. This is popular in the Ratnapura district. It takes about 10 man-hours for winnowing 40 bushels with this device. Transport of rice from the field or threshing floor to the store is done by bullock cart, tractor-drawn trailer, lorry and men. The bullock cart is the most common form of transport at present.

Conclusion

Ceylon is said to have the lowest percentage of cultivated land in food crops in the whole of Asia. 70 per cent. of Ceylon's cultivated acreage is under non-food crops. There is a population of over 8 million in Ceylon, and this increases at the rate of 200,000 per annum, i.e., more than double the world's average. The total consumption of rice in Ceylon is about 925,000 tons per annum. At present about 439,000 tons of rice at a cost of nearly 325 million rupees are imported every year. While concentrating on improved methods of production to step up the yields, it would appear essential to bring new irrigable land under rice to compensate for the low yields obtained at present and to keep pace with the increase in population. The man-power is available in Ceylon, but the land is limited in extent and there is a shortage of cattle for cultivation work in new land development schemes. For quick results in the matter of self-sufficiency in rice, jungle land in the dry zone suitable for rice cultivation needs to be opened up by machinery and cultivation operations mechanized thereafter as far as possible. In such schemes, "postage stamp" holdings, like those existing in most parts of the country, should be avoided so that machinery could be utilized efficiently and economically. As most of the farmers in Ceylon are too poor to purchase machinery, either the State or Co-operative Societies will have to own the machinery and undertake work on a custom basis as is done in certain parts of the country at present.

Paddy 'Blast'—Its Causal Organism, Infectivity and Spread

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The seriousness of leaf diseases affecting cultivated crops has been recognized as far back as 1869 with the arrival of the coffee leaf disease in Ceylon, and in more recent times blister blight and oidium diseases take their annual toll of tea and rubber plants respectively. Paddy which forms the major cereal crop in Ceylon, is not free from such leaf diseases. The most disastrous of all is "blast" caused by the fungus *Piricularia oryzae*. The disease was first reported in Ceylon in 1920 and has now become an increasingly important menace to paddy cultivation.

Behaviour of the Pathogen

The fungus *Piricularia oryzae* produces characteristic spots on the leaves of the paddy plant and thereby reduces the effective photosynthetic area of the leaf. In severe cases of attack numerous spots develop and the entire leaf becomes necrotic. Like all parasitic fungi it absorbs nourishment from the host and consequently weakens the plant. The fungus is capable of attacking the panicles and may result in empty earheads or their premature fall by producing a rot at the nodes or the base of the earhead. The latter condition is popularly called 'neck-rot'.

Piricularia oryzae produces innumerable microscopic spores which form the chief infective bodies. The spores are disseminated to great distances by the wind, settle as minute particles on vegetation and, on reaching a susceptible host, germinate within a period of a few hours. Under favourable conditions of moisture and temperature the spore germinates producing one or more germ tubes. Each germ tube gets swollen at its tip into a spherical sac-like body called the appressorium. The spore attaches itself to the leaf surface by means of the appressorium; hyphae develop from the latter which penetrate into the host tissues causing infection. The most critical period in the life history of the fungus is from the time the spore is liberated to the air and until infection is established, during which time the spore is dependent on its own resources. The spots produced on leaves are at first bluish or pale green in colour but soon become grey or straw coloured with the development of the spore-bearing hyphae and spores in the central part of the lesions. If the spots tend to be numerous they coalesce and the entire leaf blade may be killed. Repeated attacks of "blast" and successive killing of leaves weakens the plant considerably and may often cause death of the root and shoot systems. Paddy plants killed by "blast" appear sunken in the mud.

Paddy plants killed by " blast "
(within circle)

Factors affecting Infectivity

Climatic conditions favourable to attack by *Piricularia* are essentially the presence of continuous rain or settling mist, a humid atmosphere and absence of sunshine. Local microclimatic conditions produced by prolific vegetative growth and excessive shade predisposes the crop to disease ; infection may also persist along water channels or streams. The therapeutic value of sunlight in arresting blast has been reported by many workers ; it has been observed that during an epidemic of this disease if a spell of dry weather accompanied by direct sunshine intervenes the spread of the disease may be arrested to a considerable extent.

Epidemics of blast occur following rough weather, such a condition being attributed to the mechanical action of the wind whereby the entry of the fungal parasite is greatly enhanced by bruises or wounds in the host tissue produced by wind action.

Age of the plant is another important factor determining susceptibility to disease, for it has been established that seedlings are highly susceptible but become increasingly resistant with the growth of plants. This increasing resistance with advance in age of the plant is attributed to progressive thickening of the cuticle and silification of host tissues. Toughness of the leaf-blade and its silica content has been co-related with resistance : application of silicic acid to the soil has been reported to decrease the susceptibility to blast. In addition to mechanical resistance provided by the plant surface, certain varieties of paddy manifest an internal biological resistance to fungus invasion. Internal resistance is governed by certain physiological factors within the plant and may be found in varying degrees in different varieties.

Soil water and nutrients are among the factors known to influence resistance to blast. It is recognized that an adequate supply of water in the soil or the longer it remains damp the greater is the resistance. Excess of nitrogen in the soil predisposes the plants to infection ; a striking parallelism has been noted between the intensity of infection and the additional amounts of nitrogen applied to the soil. Excessive amounts of nitrogen cause the decline in the thickness of leaves and of their epidermal cell walls and, as a consequence, fungus invasion is facilitated.

Factors affecting Spread

The disease may spread in two ways, (1) by seed transmission of infective material and (2) by wind-blown spores.

The rapidity with which the fungus spreads is determined by two major factors: the amount of inoculum and the chance of the infective bodies reaching a susceptible host.

Patchy distribution of severely infected plants which is so characteristic of soil-borne pathogens is frequently seen in "blast" affected fields. Such a condition may be brought about by factors such as insufficiency of water in the soil, excessive amounts of nitrogen or presence of a local microclimate favourable to attack. Such affected patches constitute the major foci of infection and spread of the disease. At these foci of infection a high concentration of the inoculum exists but it becomes distributed and diluted gradually by the wind and the concentration of the inoculum decreases progressively with increase of distance from the point of production of the inoculum. On this principle of dilution and dispersal it may be recognized that the greatest danger to a crop depends on the presence of diseased plants producing a high concentration of the inoculum within the crop itself; the greater the distance diseased plants are situated the lesser the chances of infection.

Another important source of infection is from alternative host plants. The fungus *Piricularia oryzae* perennates on the common weed *Panicum repens* found on bunds and water channels in Ceylon. This alternative host harbours the pathogen for long periods and continues to be a constant danger to the neighbouring healthy crop.

DEPARTMENTAL NOTES

RECENT ADVANCES IN AGRICULTURAL TECHNIQUES AND PRODUCTION

WITHIN THE sphere of the agricultural activities assigned to the Department of Agriculture, viz., research extension and education in matters relating to crop and animal husbandry (but excluding the major plantation crops), notable advances have been made in recent years. In this review attention will be focussed on a few of the more important achievements and research findings which the department needs to bring to the notice of the agriculturists of the Island.

In the field of crop husbandry concentration of effort has been directed mainly to paddy research and extension work. Many advances have thus been made in all aspects of paddy research. Of interest to growers is the fact that the rice hybridization programme started some years ago has begun to deliver the goods. Four strains of hybrid origin were issued during the year, H. 106 being the most outstanding. Of local selections the *Murungakayans* have given high yields besides exhibiting a high degree of fertilizer response and resistance to drought. These selections are steadily replacing the popular *Vellai Illankalayan* of the dry zone and are showing considerable possibilities even in the wet zone. The investigation of Japanese techniques involving factors such as response to transplanting, inter-cultivation, weeding, fertilizing, &c., has yielded valuable information. Very satisfactory results have been obtained not only on Government farms but also on private holdings wherever these techniques have been adopted. The study of problems relating to certain paddy soils and manuring has revealed that a number of obscure pathological conditions in the poorly-drained paddy fields of the coastal belt is associated with iron deficiency or excess. The disease known as the " bronzing " of paddy has now been shown to be due to an excess of iron in these soils. Liming and drainage will remedy this condition. On paddy soils where iron is in short supply, sulphate of ammonia has been found to be an unsuitable fertilizer for use. Under these conditions either urea or cyanamide will be more satisfactory. The beneficial effect of a top dressing of sulphate of ammonia to the crop under normal paddy soil conditions has now been well established. The problem of alkali soils in the dry zone paddy areas has been successfully solved by applications of gypsum at 5 cwt. per acre.

Considerable advances have been made in the study of the pests and diseases of the rice crop. Measures for the control of the pentatomid bug have now been fully determined and a serious outbreak of this pest in the Southern Province was brought under effective control by the use of the latest insecticides. Advances have also been made in our knowledge of the control of the paddy stem borer and of the paddy bug. An interesting finding has been that the paddy bug which was previously easily controlled by applications of BHC dust is now beginning to show resistance to this insecticide in areas where it has been previously used. A new sprayer of the knapsack type was designed for the successful spraying of the rice crop.

On the disease side attention was mainly directed to the study of *Helminthosporium* and *Piricularia* (blast) diseases of paddy. Dressings of organo-mercurials proved to be the most effective means of controlling seed-borne *Helminthosporium*. Fernasan, a non-poisonous product, was only slightly less satisfactory. Laboratory trials for the control of blast disease showed that dithiocarbamates were highly efficient for the purpose. Organo-mercury compounds were also highly effective. Control of " blast " disease in the field was obtained by using copper dusts. The paddy variety *Murungakayan* exhibited a high degree of resistance to *Helminthosporium* attack. Thanks to the gift of the Canadian Government, viz., ten fully-equipped pest control vans, a pest and disease control service was brought into operation and proved of considerable value in the control of outbreaks of pests and diseases.

For several years previously large numbers of trial plots had been established in cultivators' fields to demonstrate the efficacy of known agronomic practices, e.g., transplanting, manuring, weeding, &c. Last year, for the first time, simple statistical experiments were set down in cultivators' fields to obtain more precise information on manuring responses. These trials will undoubtedly increase our knowledge of manuring paddy under varying soil conditions.

A technique suggested by the Senior Assistant, Kalutara (Muh. E. A. Pieris), known as the "broadling" of paddy, which consists in broadcasting paddy seedlings, has been tried out at a few of our stations and on a number of private fields and offers possibilities under certain conditions in the boggy paddy soils of the coastal areas of the Island. More investigations are being carried out on this new technique to ascertain its advantages and limitations.

Further attention has been given to the mechanization of rice cultivation as a means of solving the labour problem. In addition to primary tillage and threshing, it has been found that drilling seed, inter-cultivating drilled paddy, and winnowing can now be done mechanically. A large-scale trial with the drilling of seed paddy by tractor proved successful at Hingurakgoda.

Dry farming or the cultivation of arable crops under normal rainfall conditions continues to be the subject of intensive study at the the Maha Illuppallama Dry Zone Research Station which has been established largely through a generous grant of £500,000 by the New Zealand Government. It is noted that there has been a rapid decline in yields of crops on this station during the last four years despite manuring, and that soil fertility can only be conserved by the maintenance of a good physical soil structure. Investigations to determine how this could be achieved are being continued. One important fact has emerged from this work, viz., the traditional tillage practice of soil inversion by the plough is unsuitable under the conditions obtaining in the dry zone of the Island. Stubble mulching has proved beneficial and special sub-surface tilling implements are in vogue for the purpose. Poor seed germination has been remedied by drilling in clean lanes. Maha Illuppallama has also demonstrated that upland rice can be very successfully cultivated on the unirrigable bottom lands of the dry zone provided satisfactory weed control is effected. The use of weedicides and the rotary weeder have produced excellent results, the average yield of crop in the experimental area during *maha* 1954-55 being in the region of 70 bushels per acre.

A crop which has made considerable headway during the past few years is cigarette tobacco, the extent cultivated being now estimated at about 5,000 acres per annum. The crop is becoming increasingly popular in the Jaffna Peninsula with the decreasing market for Travancore tobacco. Large-scale trials at Hingurakgoda and Anuradhapura have shown that cigarette tobacco can be successfully cropped on paddy land in *yala* under controlled irrigation.

Other features of our studies on crops which might be mentioned are :

(*a*) The successful evolution of a new cotton selection (S 6) to replace BP 79. This strain has a longer staple, is much less neppy, and spins a higher count than the latter.

(*b*) The sugar cane variety Co 527 is significantly superior to other varieties not only in sugar yield but in its adaptability to varying soil conditions.

(*c*) A selection of high-yielding Amelonado cacao giving an average yield of 300 pods per annum has been made.

(*d*) Ramie fibre (*Boehmeria nivea*) grows successfully on well-drained soils in the wet zone and shows remarkable response to organic manure applications.

(*e*) *Brachiaria brizantha* (signal or pasture grass) has proved very successful as a pasture grass under the soil and climatic conditions of the dry zone. It is also eminently suitable for the wet zone. About 10,000 acres are now under this species.

(*f*) The inclusion of diesoline in pentochlorophenol weedicides for the control of *Salvinia* increased their efficiency and reduced costs.

(*g*) Orchid breeding has made considerable progress at the Peradeniya Botanic Gardens and a large number of crosses between imported and local varieties has been produced.

Mention should here be made of the Government subsidy scheme introduced recently for the replanting or underplanting of uneconomic rubber with cacao in areas suited for the latter. The rehabilitation scheme is being worked by the department, assisted by an Advisory Committee. It is thus hoped to increase the Island's acreage under cacao by about 15,000 in five years.

In regard to new departures in the field of agricultural education, reference need only be made to the day practical agricultural school for girls at Kundasale and the new school for training dairy workers at Ambepussa Farm. Over 500 students qualified in modern agricultural methods pass out of our schools each year.

Brief comment on the Young Farmers' Club movement, started in 1951, is necessary. Over 500 clubs have now been established and these cater to the needs of nearly 40,000 young farmers. The movement is developing into a strong, sturdy agricultural child.

Work on soil conservation has progressed satisfactorily in the declared erodible area, covering the major part of the tea districts of the Island. Land use and capability surveys have been made with a view to recommending suitable conservation measures for adoption in the area.

Very satisfactory progress has been made with the promotion of animal husbandry in the Island during the past few years. A reorganization of the main animal husbandry farms has been effected so that each has now certain definite objectives. These farms have furnished valuable information on the breeding and management of livestock under varying climatic conditions and also good quality breeding material to the public for the upgrading of their stock. It is pleasing to record that they were responsible for issue to the public by sale, or under a bull calf exchange scheme now in operation, of over a thousand head of livestock, mainly cattle and buffaloes. The milk produced on the major cattle farms which was issued to hospitals and milk feeding centres amounted to over 450,000 gallons, while the total output from all the farms of the Island amounted to nearly 575,000 gallons. Other measures recently adopted for promoting the animal husbandry industry in the country include an increase in the number of artificial insemination and stud centres, the establishment of new veterinary centres and dispensaries, the formation of livestock breeders' societies, the intensification of veterinary research, and the organization of campaigns for the control of diseases such as the Raniket disease of poultry, the castration of unwanted males, &c.

The work on the progeny-testing of young bulls and on the cross-breeding of Sinhala cattle and local buffaloes with imported breeds has proceeded to a stage when practical results will be forthcoming before long. A nutrition trial with poultry has conclusively demonstrated that feedingstuffs of adequate quality for high egg-production are available in adequate quantity in the Island. Poultry development in the Island has been given an impetus with the establishment of a poultry station at Karandagolla (Kundasale) which in the short period of 6 months produced over 25,000 day-old chicks for issue to breeders.

An important feature of the veterinary laboratory services is the production of almost the entire requirements of biologicals in use in the Department for the control of animal diseases. Research investigations from which information of considerable practical value to veterinarians and livestock breeders has been obtained include those on the paralysis (*Cerebro-spinal nematodiasis*) of sheep, goats and horses, *Haemorrhagic septicaemia* and bovine sterility. An epidemic of *Haemorrhagic septicaemia* which broke out in several parts of the dry zone was brought under control with a vaccine prepared in the Veterinary Research Laboratory for the first time.

Before completing this review reference should be made to the farms run by this department, which now number 50 units and comprise experiment stations, plant multiplication and stock supply centres, school farms and nurseries. In addition to fulfilling the objectives for which they were established, it is very satisfactory to record that, taken collectively, they have ceased to be a heavy liability to the State. The income from these units has risen from Rs. 2.3 million in 1948-49 to 4.4 million in 1954-55, while expenditure has decreased from Rs. 7.9 million to 5.1 million during the period.

In concluding this review on recent developments in agricultural techniques and production, mention should be made of the successful results that have attended the efforts of this department along with those of the Food Production and Revenue Departments in the work of food production. It is now known that the Island produces over 50 per cent. of its requirements of rice despite the fact that the population has increased at the rate of over 200,000 per annum, as compared with less than a third of our needs a few years ago. Statistical surveys have revealed that the average paddy yield is now 32 or 33 bushels per acre, the highest so far recorded since this method of estimation came into vogue. Production has also increased with other crops, e.g., the Island produces almost its total requirements of onions. With the formation of the Milk Board and the provision of marketing facilities there has been a considerable increase in the output of milk in the Island, and developments in poultry husbandry and other animal industry activities are noteworthy.

A. W. R. JOACHIM,
Director of Agriculture.

REVIEWS

Principles and Practices of Field Experimentation—J. Wishart and H. G. Sanders (2nd edition)

Technical Communication 18 of the Commonwealth Bureau of Plant Breeding and Genetics, Cambridge

THIS BOOK falls into two parts. The first part deals with the principles of field experimentation while the second deals with the practical considerations in the lay-out of the experiments.

Those who had read Dr. Wishart's earlier books on field trials would find this portion an excellent summary. However, if it is read for the first time, the reader is bound to feel a little troubled with the pace of the book. Terms are defined in rather rapid succession leaving too little time for the reader to absorb the ideas. This is a natural consequence of attempting to cover all the ground from 't' test to analysis of variance and covariance in methodology, and from simple randomised block to factorial, splitplot, lattice squares in designs—all in the space of 73 pages.

There are very few text books on statistical methods and designs which lay sufficient emphasis on the practical aspects of experimentation. Dr. Sanders, in the second part of this book, fills this gap in abundant measure. His treatment of every aspect of experimentation in the field is so thorough that research workers would do well to "chew and digest" this portion. Perhaps, the emphasis he places on Observation Plots, the performance of which has to be judged by eye, is a little too academic. In any case, it is difficult to agree with Dr. Sanders that "the successful plant breeder is still the man who has an instinct for "spotting the winner".

P. K.

Veterinary Guide for Farmers—G. W. Stamm

(2nd edition, 1951) Chicago : Windsor Press. 384 pages : Price $ 3.95 (U. S. currency)

THE FACT that this book had six printings indicates its value and popularity among owners of farm animals. The book is useful to large-scale producers of dairy and meat products and eggs as well as to owners of single animals.

This Island faces a shortage of qualified veterinarians and many stock-owners have inadequate veterinary aid. Further, conditions are such that stock-owners and milk-producers cannot either afford the services of qualified veterinarians or obtain their services when they want them. Therefore, a book of this nature is bound to be of great help. It is true that it is usually false economy for untrained men to be their own veterinarians but a knowledge of animals in health and disease by stock-owners can contribute towards the reduction of losses among farm animals.

This book gives all that is required of the elements of Veterinary Science. Our local livestock-owners will find the book somewhat advanced and technical because an average stock-owner in this country does not possess sufficient background knowledge of livestock health problems.

The book contains descriptions of all species of livestock and of the diseases affecting them. Dairy and meat cattle, pigs, sheep, goats, and poultry are all dealt with. (Most of the diseases described in this book exist in this country.) There are also chapters on artificial insemination and on plants poisonous to stock.

This book should serve as a practical farm guide in the care, treatment and prevention of common ailments of farm animals to students of the Schools of Agriculture at Peradeniya and Kundasale. It will also be of great value to agricultural field staff and

non-qualified veterinary assistants employed in the Veterinary Section of the Department of Agriculture.

The book should find a place on the book-shelf of all those who own livestock and poultry and of all officers who, in their day-to-day activities, deal with livestock.

C. P.

Recent Research on Vitamins—Memorial Number to Sir Edward Mellanby

British Medical Bulletin, Volume XII, No. 1, January, 1956

Published by the Medical Department, The British Council, 65, Davies Street, London W. 1

(*Price Fifteen Shillings*)

THIS NUMBER of the British Medical Bulletin is wholly devoted to the subject of Vitamins. It is a symposium planned by a committee presided over by the late Sir Edward Mellanby.

The major party of the contributions deals with the medical aspect of the functions of the vitamins and refers to clinical and biological observations.

An interesting account is given on Vitamin B_{12} with its tentative structural formula This vitamin contains a metallic element, namely, cobalt. Surprisingly enough no other vitamin so far discovered has a metal in its structure. It is known to play an important part in the digestive process.

The paper relating to vitamins in animal nutrition deals with advanced work in this field.

The paper on the effect of processing on the vitamin content of foods is an account of recent work in this field. Lastly, the article on vitamins in nutrition deals with modern trends in research.

C. C.

Commonwealth Economic Committee

THE COMMONWEALTH Economic Committee, with Headquarters at 2, Queen Anne's Gate Buildings, London, S. W. 1, England, was first constituted in 1925. All Commonwealth countries are represented on the Committee and contribute towards its working expenses. Its functions are purely advisory, and deal mainly with the possibilities of improving the methods of preparing for market and marketing within the United Kingdom, the economic products of the Commonwealth with a view to increasing the consumption of such products in the United Kingdom in preference to imports from foreign countries, to promote the interests both of producers and consumers, and to examine and report on any economic question that the Government of the Commonwealth may agree to refer to the Committee.

2. From time to time, the Committee prepares special Reports to members Governments at their request. They deal with particular subjects and are submitted to all Commonwealth Governments jointly.

3. The Intelligence Service of the Committee includes the periodical collection and publication weekly, monthly or annually of current economic information on production, trade and marketing of particular agricultural commodities which are of direct importance to the countries of the Commonwealth. The subjects dealt with are mainly connected with agricultural products used either for food or industry.

4. The services are of three kinds. World surveys or studies of the production and trade in particular commodities. These appear from time to time as required.

5. The Commodity Series, which is a regular part of the Committee's arrangements for publicising economic intelligence and bringing together, in a comparative and convenient form, information on the production of, and trade in groups of closely allied commodities. This series at present consists of the following publications: Meat, Fruit, Grain Crops, Industrial Fibres, Plantation Crops, Vegetable Oils and Oil Seeds, and Dairy Produce.

6. The statistical tables in this series include figures for all countries of the world, and therefore serve as a valuable guide to the economist, businessman and practising planter.

7. The third service consists of periodical intelligence services dealing with current up-to-date information on a particular subject of interest to Commonwealth countries. These publications are issued free of charge to member Governments, of which Ceylon is one. They are also available for sale to the public at the Committee's Headquarters and H. M. Stationery Office, London, at very reasonable prices.

H. T. P. S.

CENTRAL BOARD OF AGRICULTURE

PROCEEDINGS OF THE SECOND MEETING OF THE RECONSTITUTED CENTRAL BOARD OF AGRICULTURE HELD AT THE SCHOOL OF AGRICULTURE, PERADENIYA, ON FEBRUARY 27, 1956, AT 2.15 P.M.

Dr. A. W. R. Joachim, Director of Agriculture, presided, and the following were present :—

Mr. C. A. M. de Silva, Vice-Chairman ; Major E. C. de Fonseka ; Mr. S. Arumugam, representing the Director of Irrigation ; Mr. N. Manicka Idaikkadar, C.C.S., Director of Food Production ; Senator B. Ivor Palipane ; Mr. Ray Wijewardene ; Mr. R. H. Spencer Schrader ; Sir James P. Obeysekera ; Mr. W. M. Cumaraswamy ; Mr. S. L. Bandara Dharmakirti ; Mr. S. Pathmanathan ; Mr. R. H. De Mel ; Mr. N. R. B. Thalakada, representing the C. C. D. and R. C. S. ; Mudaliyar N. M. Abdul Cassim Marikar ; Dissawa S. A. I. Elapatha ; Mr. M. B. Samarakoon, D. R. O. ; Mr. A. L. B. Pethiyagoda, D. R. O. ; Muhandiram T. B. Ekanayake ; Mr. Arthur Weerakoon ; Mr. D. B. Ellepola ; Mr. M. D. W. R. Saparamadu, representing C. D. M. ; Mr. G. B. Portsmouth, Director, Tea Research Institute ; Mr. J. A. de Silva, Conservator of Forests ; Mr. F. C. Cooke, Director, Coconut Research Institute ; and Mr. A. V. Richards, Chief Research Officer, officiated as Secretary.

The following departmental officers were present by invitation :—

Mr. T. M. Z. Mahamooth, Deputy Director (Animal Husbandry) and Government Veterinary Surgeon ; Dr. W. R. C. Paul, Deputy Director of Agriculture ; Mr. D. V. Ariyanayagam, Acting Botanist and S. A. R. O. ; and Mr. T. Wickremasinghe, Soil Conservation Officer.

Letters and telegrams regretting inability to attend the meeting were received from the following :—

Mr. N. P. Wijeyeratne, C.C.S., Secretary ; Mr. Anton Ponnampalam ; Mudaliyar S. Armstrong ; Senator Lady Molamure ; Mr. K. W. Devanayagam ; Mr. Kenneth Morford ; Mr. V. Ratnayake ; Mudaliyar M. M. Ebrahim ; Director, Rubber Research Institute ; Mr. A. M. Clement Dias ; Mr. C. T. Van Geyzel ; Mr. J. M. Sabaratnam ; Hon. Mr. N. Keerthiratne ; Senator (Mrs.) Clodagh Jayasuriya ; Mr. E. Muthucumaru ; and Mr. K. G. Sinclair, Chairman, Planters' Association.

I—Confirmation of the Minutes of the Last Meeting

Chairman—"Are there any comments or amendments you would like to make on the draft minutes ?"

Mr. D. B. Ellepola—"There are a few corrections I would like to make—

In page 2 under para 4 'Adoption of rules' *lost board* should be *last board.*

There is reference in the minutes on page 5, left hand column to *Mahapalata District.* This should be *Mahapalata Korale of Udispattu division.*

There is also a reference to *Uda Nuwara* and *Yati Nuwara ;* it should be *Udukinda and Yatikinda."*

Chairman—"Normally the procedure is to send the minutes to the various speakers for amendment. I do not know whether this was omitted in this instance. Subject to the few amendments suggested, do you approve of my signing these minutes."

The minutes of the previous meeting were then confirmed.

II—Matters arising from the Minutes of the Previous Meeting

Chairman—"I am advised that there are certain names to be included in the list of members of the Agricultural Minor Products Sub-Committee. There are already 8 members and I propose that the following 3

be added : Messrs. H. B. Rambukwella Dissawa, Kenneth Morford and Senator (Mrs.) Clodagh Jayasuriya."

The proposal was approved.

"There are two matters arising from the previous meeting :—One is in respect of the motion brought up by Mr. Ray Wijewardene in regard to long-range weather forecasts. Action has been taken by us on this matter and we have written to the Director of Meteorology and the Secretary, Posts and Broadcasting. I hope that something will come out of it. Provision has been asked for staff for the next financial year. Nothing can be done till then.

The other is in regard to a motion by Major Fonseka with regard to *patana* fire-fighting organizations. Arising from that we wrote to Mr. Fonseka to indicate the type of co-operation which officers of various departments could give in regard to such organizations. Mr. Fonseka has sent us a memorandum which is being circulated to members. It contains certain suggestions with regard to requests to be made to various departments. Mr. Fonseka, would you like to speak on this ?"

Major E. C. de Fonseka—"It is all here Sir ; it is quite simple."

PATANA FIRE FIGHTING ORGANIZATION

1. The sole purpose of forming a Volunteer Patana Fire Fighting Organization is to organize a group of public-minded citizens in rural areas who would try to stop a *patana* fire as soon as it is detected, thereby preventing its spread. This will prevent damage to life and property. It is with this intention in view that this suggestion was put forward.

2. Since it is the function of the Inspector General of Police to protect life and property of the citizens in Ceylon it is suggested that all voluntary organizations be organized under this department in areas in which a Police station is located. The officer-in-charge of the Police station should round up as many helpers as he can from the area, especially at the time that *patana* fires are most prevalent, which is usually the period of drought preceding a rainy season. The Ministry of Home Affairs should be informed to request all Government Agents and Divisional Revenue Officers to request the Rural Development Societies in *patana* areas to forward a few names of its members to serve on this organization and inform the local Police authorities of these names so that they might be co-opted into the volunteer movement.

The Director of Agriculture should instruct every member of his department in *patana* areas to report to the local Police Constabulary of his willingness to join this organization. The Director of Public Works should be instructed to request all overseers in *patana* areas to join this voluntary organization, too. The Conservator of Forests should be requested to instruct his officers to report to the local Police of their willingness to join the above organization. The Ministry of Local Government will have to be approached and requested to inform every Village Committee in the area to inform the local Police Officer names of its members who are willing to serve in this organization.

3. In Diyatalawa itself efforts should be made to obtain the assistance of the Military Service personnel and also those of the Survey Department training centre.

4. In areas where there is no Police Station the Ministry of Home Affairs will have to be informed to request the Divisional Revenue Officers in *patana* areas to request the Village Headmen to form Volunteer Fire Fighting Organizations in these areas with the assistance of Rural Development Societies.

The Ministry of Local Government will have to be approached to suggest volunteers from Village Committees in these areas. The Director of Agriculture should issue instructions to all his field personnel to join these organizations, too.

5. In the case of areas declared as erodible under the Soil Conservation Act, No. 25 of 1951, such as the Kotmale Revenue Division in Nuwara Eliya District and Uda Bulathgama Revenue Division in Kandy District,

the technical officers of the Soil Conservation Division, Department of Agriculture should, be instructed to organize this work in close co-operation with the Police force and Village Headmen and relieve the Police Department and Village Headmen of this responsibility as these functions have been handed over to them under the Soil Conservation Act.

6. The Revenue Districts in which *patana* burning is a major problem are those of :—

1. Nuwara Eliya
2. Kandy
3. Badulla
4. Matale
5. Kegalle
6. Ratnapura
7. Galle
8. Matara.

Mr. N. Manicka Idaikkadar—"We have not seen it before."

Chairman—"The report was sent only a few days ago. Are there any comments ?"

Mr. D. B. Ellepola—"May I suggest Sir, that as this is a problem which directly concerns the Rural Development Department, we enlist their co-operation by referring it to the Director of Rural Development for his comments. It is a departmental set-up to deal with our rural problems in which people must participate. Organizations such as Fire Fighting Squads must be tackled by Rural Development Societies ; the organization itself must be brought to their notice as it is their own structure. For that reason it can be sent to the Director of Rural Development for the favour of his observations in the first instance. This would save a lot of trouble."

Chairman—"There are other departments as well who are interested in this matter."

Mr. D. B. Ellepola—"The Rural Development Department will draw them all up and get one mind of it."

Chairman—"I think we should address the Ministry of Home Affairs in the first instance."

"Thank you very much Mr. Fonseka for your memorandum."

Mr. R. H. Spencer Schrader—"I would like to draw your attention to a motion brought up by me and which was postponed from time to time. At the last meeting I was informed that this matter would be taken up at this meeting. I therefore did not think it necessary to write again. Then I got the Agenda and I found that my resolution was omitted from it. I wrote in, and the Secretary replied :

'I regret very much that I omitted your resolution purposely, but without your permission.

I thought that it might be more convenient to have the resolution discussed by the Sub-committee on Animal Husbandry and forward its report to the Central Board.

I trust that you will not take my action amiss.'

"Surely if it was to be referred to the Sub-committee for Animal Husbandry that was a matter for the Board to decide. I believe that the previous Board maintained that resolutions sent in had to be on the agenda. In this case it was omitted at the discretion of the Secretary, which I do not think is quite regular. I would like to know whether this is going to be a regular practice ? If it is there is no use sending any resolutions."

Chairman—"This is a matter of procedure. We are quite willing to abide by what you decide. The point at issue is this : Mr. Schrader sent a resolution for discussion ; the Secretary suggested and I agreed that this resolution might be first discussed by the Sub-committee and then put to the Board for consideration. But if you decide that any motion should come up first to the Board and thereafter be considered by the Sub-committee I will abide by your decision."

Mr. D. B. Ellepola—"May I say that I am in full agreement with the procedure adopted by the Secretary. Suggestions must be first referred to the Sub-committee and then to the Board so that the committee could embody it at the appropriate time and also include its views in the report. In that way we can save a lot of time. Any resolution must in the first instance be referred by the Secretary to the Sub-committee and the Sub-committee could decide and put it up to the main Board. Instead of bringing various matters for discussion here it could be discussed by the Committee. It is really there that the work has to be done.

Reference to the Sub-committee in the first instance should be continued except in the case of a matter of an overall nature which could be brought to the Board for discussion."

Senator B. I. Palipane—"The normal procedure in regard to resolutions seems to be that a resolution brought by a member must be discussed in the house itself and, if the main Board so desires, it may be referred to the Sub-committee for further report in the first instance. It seems to me that every member should have the right to move a resolution at the Board itself, and the Board, after scrutiny, can refer it to a Sub-committee for detailed report. Give any member of the Board the right to bring a motion to the main body prior to referring it to any Sub-committee."

Mr. C. A. M. de Silva—"The resolution should be adopted by the Board and then be submitted to the Sub-committee."

Chairman—"It is generally agreed that the resolution should be brought to the Board and then submitted to the Sub-committee for discussion. I apologize to Mr. Schrader if we have intentionally omitted his resolution. Mr. Schrader's resolution could now be taken up."

Mr. Spencer Schrader—"I would rather prefer that it be postponed for the next meeting as I have not brought my papers and I am not prepared to discuss it."

III—Co-option of the Director of Irrigation and the Deputy Director of Agriculture (Animal Husbandry) to the Paddy Advisory Sub-committee of the Board

This was unanimously agreed upon, and the Chairman included Senator B. I. Palipane also in the Sub-committee.

IV—Resolution to be moved by Gate Mudaliyar N. Wickremaratne

"That in order to meet the shortage of farm hands and also to give a working knowledge of paddy cultivation to those attending school in rural areas, arrangements should be made that such students get their holidays during the cultivation season and harvesting season of the year."

Chairman—"I have had a letter from Mudaliyar Wickremaratne requesting us to postpone his resolution. If it should be referred to a Sub-committee we can do so or do you prefer that it be put back for the next meeting when the Mudaliyar will be present."

Mr. D. B. Ellepola—"There may be cases when the matter may be discussed and action taken immediately. I think the usefulness of bringing up a motion of this form is that some action is possible."

Chairman—"In this instance would you like it postponed?"

Mudaliyar N. M. Abul Cassim Marikar—"In the absence of the mover of the motion it should be postponed."

Chairman—"Then it will be postponed for the next meeting."

Senator B. I. Palipane—"May I suggest that the Director of Education be made a member of the Board as we have a number of functions to perform in consultation with him."

Chairman—"I will bring this matter to the notice of the Ministry and ask what they have to say about it. But what I feel is that officers should not unnecessarily be called away from their legitimate duties. If you accept this position we will write to the Director of Education and invite him for the next meeting when the resolution will be discussed."

This was agreed to.

V—Resolutions to be moved by Mr. S. Sirinivasan, D. R. O., Vavuniya South

"1. That the subsidy granted by Government for the construction of wells is totally inadequate compared to the total cost of completing a well in the Vavuniya District. This Board requests Government to increase the subsidy to at least 50 per cent. of the cost of construction.

II. That the Food Production Department be requested to place the jungle clearing and rock blasting machinery at the disposal of the farmers to assist in quicker and more efficient development of land for food production."

Chairman—"Mr. Srinivasan is not here. In the circumstances we will have to postpone this resolution too for the next meeting."

Mr. S. L. Bandara Dharmakirti—"At the last meeting the question was brought up about water for land that was parched up. These are local matters that should go to the District Agricultural Committees. The Vavuniya area should be considered by the D. A. C."

Mr. Manicka Idaikkadar—"The total cost is inadequate. The recommendation is for Government to make it 50 per cent. for the whole Island."

Chairman—"Would you like it referred to the Director of Food Production?"

Mr. Manicka Idaikkadar—"I would prefer it to be postponed."

VI—Resolution to be moved by Major E. C. de Fonseka

"That in view of the rapid dwindling fauna of the Island specially the elephant, this Board recommends to the Ministry of Lands and Land Development to take immediate steps to formulate a scheme so that corridors be demarcated to enable Game sanctuaries and reserves to be connected wherever possible."

"That the Settlement Officer be instructed not to settle lands falling within the demarcated areas."

"That the Land Commissioner be instructed to take steps through the G. AA. to prevent infringement of these corridors."

Major E. C. de Fonseka—"Chairman and Gentlemen, I rise to propose the motion standing in my name. In doing so I would like to make a few remarks. I feel, gentlemen, that immediate steps should be taken to prevent the total extinction of a very valuable asset belonging to this country, and which also happens to be our national emblem—I refer to the Elephant. It is not only a loss to the country but it will also be a loss to natural history, because in no other place in the world do we have the same type of animals as in Ceylon. The Elephant of India is quite different to the Ceylon Elephant and the African Elephant belongs to an entirely different species. There are in the Island only six places where Elephants can have some sort of security and safety. They are the Sinharaja Forest, Sri Pada Forest, Gal Oya Reserve, Yala Sanctuary, Wasgamuwa Reserve and Wilpattu National Park. As a result of the indiscriminate clearing of land mostly by illicit *chena* cultivators and as a result of faulty land policy on the part of Government these animals are confined to isolated areas with insufficient food and water for them, and as a result of insufficient food and water they get into cultivated lands and a constant battle takes place between man and animal, and man with his deadly weapons is always the winner. My proposition is that we should have corridors so that one forest can be connected with another. It is not possible to connect Sinharaja and Sri Pada owing to the intervening land being opened out in various cultivations, but the others could be connected. It is possible to have a corridor so that animals can move from the Yala Sanctuary to the Gal Oya Reserve and thence through Wasgamuwa Reserve through Manampitiya area to the North of Vavuniya and then southwards through the Mantai and Moosali Division of Mannar to the Wilpattu National Park. In this connection, gentlemen, I hope the day will not be far off when Government will form a National Trust which is very much overdue. If animals have more room to move about and more food available there will be less damage to crops. We see in the papers how elephants ruin cultivations and how they are shot at and how they die lingering deaths. I am sorry my motion is long-winded but I would like to draw particular attention to Para 3 of my resolution. If this scheme is to be a success, drastic steps must be taken to see that corridors are kept intact. Very stern measures will have to be taken to prevent the clearing of these corridors. The greatest damage by illicit cultivation is caused by the large *mudalali*. He employs a poor cultivator and gets him to open out large tracts of land. He robs the Government and the poor cultivator but he never gets caught. Very often these clearings are used for the illicit cultivation of ganja as we have seen at Ambegamuwa. Some stern action should be taken, if, as I said, this scheme is to be a success, to see that no encroachment takes place. I do not think,

gentlemen, I need waste your time any longer. I will formally propose the motion standing in my name and I hope my friend Mr. Ellepola will support me."

Mr. D. B. Ellepola—"Sir, in response to the invitation of the mover, my friend Major Fonseka, I have pleasure in seconding this motion, but with a slight amendment which I shall indicate. The necessity for the protection of Wild Elephants in this country has been accepted on all sides. Elephants are part of our rich heritage. Their value and grandeur is beyond doubt. We should therefore not encroach on the requirements of land and food of the animal population of this country. We should therefore accept the motion with a few amendments. We read in the papers of the dwindling elephant population, but little is done. It behoves us, as agriculturists, to consider however the practicability of the motion. If you look at a topographical map of Ceylon, you will see that it is possible to establish a continuous forest area, linking up our main reserves starting from the Yala sanctuary, across the Gal Oya basin, northwards through the forests of Maho and Polonnaruwa, Anuradhapura to the Wilpattu and Moosali. The only difficulty is, that on account of the development of village life in the bordering areas and within these areas themselves it may become necessary to displace some of our village population. But this is already an accepted method of rural development. For instance some people who were *chena* cultivators in the Galoya have been moved out from there as these areas have to be kept free from *chena* cultivation. In that way it is possible to shift villagers to other parts where suitable land is available. Thus, allowing for minor adjustments, I feel quite certain that with the first topographical maps that are at our disposal, certain continuous forest areas can be marked out and proclaimed. Demarcation does not necessarily mean definition with land marks. It is an accepted practice in topographical mapping not to follow streams, water courses, roads, &c., and in that way elaborate work is avoided. It is a matter that can be settled easily. That done, the next question would be to consider whether it is right that we should lock up such land for this purpose, when there are the important needs of agricultural development. Human needs have undoubtedly to be given priority of place, but where there are large extents of uncultivated land which could be used for that purpose, could we not zone out some land that can for some foreseeable period of time be kept free from agricultural development. If at some point of time the available land is not sufficient for agricultural development we may have to use it for that purpose but that can be decided by posterity. We need to take a long-range view of possible agricultural development of the future and then zone out an area within which we will not alienate any land, confining agriculturists outside this zone. At first we can include into the proposed forest zone, the catchment areas of major and minor irrigation schemes within which agricultural development cannot in any case be allowed however suitable such land may be for the purpose. These catchment areas can perhaps serve as the corridors linking up forest areas for the use of the animal population. Major Fonseka's last suggestion that the Settlement Officer should be instructed not to settle lands within these forest areas would not be correct. The settlement of claims to all lands must, however, go on, but it is the alienation of these lands that must not be permitted, if the land falls within the zoned area. Once claims to lands have been settled, if it is found that some of these lands coming within these corridors are private lands, it may be the right of government to acquire such land. Regarding the third part of the motion, there is now a Wild Life Department. Once these zones are marked out it will be the function of the Wild Life Department to protect these lands. If the need is accepted, and the methods and facilities are also available without damage to the agricultural development of the country, it becomes an immediate duty to make the necessary provision. I therefore suggest that Government be requested to immediately map out zones of forest land for use of animal life and avoid alienation of land within these zones. There is now a great deal of haphazard alienation of land without concern for the needs of our fauna and flora. If this continues unchecked the animal population of the country will not last for

ever. Once the land is zoned out Government Agents must accept that any kind of further development must be kept outside these areas."

Senator I. B. Palipane—"The resolution under discussion has been very ably proposed and more ably seconded. In the first instance I should like to say that I am in full agreement with the contents of the motion and I, as a Buddhist, in the year of Jayanthi, cannot have better comfort in the intention that is behind the resolution that has been placed before the house. Before I proceed further I would like you Mr. Chairman to give a ruling as to whether this motion is in order. The Motion reads as follows :—

'That in view of the rapid dwindling fauna of the Island specially the elephant, this Board recommends to the Ministry of Lands and Land Development to take immediate steps to formulate a scheme so that corridors be demarcated to enable Game Sancturies and reserves to be connected wherever possible.'

'That the Settlement Officer be instructed not to settle lands falling within the demarcated areas.'

'That the Land Commissioner be instructed to take steps through the G. AA. to prevent infringement of these corridors.'

Clauses 7 and 8 of the rules of the Central Board of Agriculture read—

Clause VII—'The Central Board of Agriculture shall have no executive authority but shall function solely as a deliberative body and shall have power to make representations and recommendations to the H. M./A. & F. or other Minister, through the M/A. & F. for the Agricultural advancement of the Island.

VIII—'The main functions of the Board will be (1) to submit proposals to the M/A. & F. for the Agricultural advancement of the Island ; (2) to advise and report to the M/A. & F. on any matter referred to it by the Minister ; (3) to disseminate information on agricultural subjects.'

Those are the main functions of the Board and I wish to know whether the contents of the resolution are in conformity with the rules of the Board. Although I am making these remarks I like to reiterate that I am in full agreement with your resolutions and I as a Buddhist feel very strongly that we as human beings should provide every protection to wild animals that are confined to isolated places in the country. The intention is to provide corridors so that animals can move with greater ease and freedom from one forest to another. The intention is a very laudable one. I would like to state very emphatically that I am in full agreement with the resolution, but it does not come directly within the functions of the Board. The last part of the resolution is that the Commissioner of Land Development be instructed to take steps through the G. AA. to prevent infringement of these corridors. That means that the Land Commissioner has a right to say whether land should be developed or not. Indirectly we can say that the Land Commissioner may not do these things in those areas which are to be protected, in order to allow wild elephants to pass from one forest to another, but strictly speaking we cannot discuss this."

Mr. D. B. Ellepola—"I disagree that this matter has no bearing on agricultural activity. It definitely has a connection with such activities. Plantations are opened out and wild animals trespass on private land and are shot down. Much of this is due to the fact that animals are confined to small pockets of forests and they necessarily must trespass on adjoining agricultural land for their needs of pasture. Forests constitute the agricultural stock of the country and the preservation of forest land is as much an agricultural matter as the production of food. The motion therefore falls well within the compass of agricultural activity."

Mr. Spencer Schrader—"Animals naturally form a part of our agriculture. The Tennessee Valley authorities have proved this beyond all doubt. They have reserves for animals and this has been done very carefully. Reservations and corridors have been reserved for animals as they form part of

agriculture. When animals suffer from drought, especially at Hambantota, &c., they break out to the open and go wherever there is water. They should be able to go to any place without interfering with cultivators. It is therefore necessary that these corridors should be reserved and I support the resolution standing in the name of Major Fonseka."

Mr. G. B. Portsmouth—"Establishment of these corridors must have a considerable effect on the agricultural development of this country."

Sir James P. Obeysekera—"Considering the length and breadth of these tracts, several departments will have to be consulted. We will have to go down rivers and valleys and I do not think that this can be easily settled. It is true we have maps, but elephant tracts will have to be followed. I wonder whether the Land Commissioner would leave these large tracts as elephant tracts."

Conservator of Forests—"I have the pleasure to inform this Board that a tentative map showing these corridors has been drawn up in consultation with the Wild Life Department but it is not put into practice for the simple reason that until a picture of the overall natural resources of the country are decided, it is not possible. It is essential that if these corridors are laid down, that they should be final, and I have a feeling that until the permanent natural resources are finalized it is rather premature to decide on these corridors. The Irrigation Department is also drawing up a map for river catchments. So we hope to get a general overall picture of the final development of the country and then we will be able to fix these corridors permanently. Until that is done the matter will be only a waste of time. When the final picture is considered part of our existing forests may have to be alienated, and I think we may have to shift the forest boundaries. For example there is an agricultural scheme near Wilpattu at the moment and until this is finalized the laying of corridors in this area is rather premature."

Dissawa S. A. I. Elapatha—"With apologies to the Conservator of Forests, what we want to suggest is that there should be a balance between animal life and human life. One gets impatient with this type of planning. The main objective does not come up. An overall view of the problem must be taken. The picture must be considered as a whole—climatic conditions, reserves, agricultural development and the needs of the animal population. We do not want to suggest that immediate action be taken by the policy of planning in an overall way. If it is immediately marked out and kept in view, some steps can be taken. By the time the development problems come into reality the animal population will be dead and gone."

Conservator of Forests—"Let it not be thought that I want to detract from this proposal but one cannot get away from the fact that at the rate of the present expansion of population certain animal groups will have to be eliminated. Hundred years ago there were 30,000 to 40,000 elephants. But then the number of people to a square mile in the Eastern Province was only fifteen. Today it is 150 to a square mile. About that period in the Northern Province the number of people to a square mile was 35. Today it is 283.

These figures will indicate that at the rate of population increase and modern conveniences that exist, this motion is most necessary and that is what I wish to emphasize, but human interests cannot give way to animal life."

Mr. S. Pathmanathan—"Could I know the elephant population of Ceylon?"

Mr. S. Arumugam (representing the Director of Irrigation)—"Mr. Chairman and Gentlemen, the contents of the motion are practical and as already informed by the Conservator of Forests some action has already been attempted in this direction. Of course it essentially concerns agriculture, and there is no doubt that the subject is of vital concern to agriculture. We in the Irrigation Department came up against it and for the last several years we have tried to settle it. Some schemes were taken up and in that connection the planning section of the Irrigation Department reviewed the whole position, the lay-out of game sanctuaries, forest reserves, &c. To start with we asked ourselves the question, "How were these originally laid out?" "How were the game

sanctuaries marked out like this ? " But we were unable to find a logical answer. " Did climatic conditions favour this ? " A suitable answer was however not found as to the present boundaries. Then we asked ourselves, " Suppose we were asked to draw up a plan, how should we do it ? " That is the plan referred to by the earlier speaker. Two or three departments are vitally concerned with the subject ; so we are writing for their comments before we submit it to Government with our recommendations. It is one of vital concern to agriculture, and now that the development proposals have been laid out by the Government for the Six-Year Plan more and more land is wanted and some of this land may have to be taken up. It cannot therefore be done without systematic planning of our natural resources. I am not suggesting that the subject be diverted on this issue. Systematic planning as a whole of the whole Island will have to be done, otherwise it will go awry. Some attempt has been made regarding natural boundaries, river basins, catchment areas, &c. An eye must be kept on these when we go into detail. "

Mr. W. M. Cumaraswamy—" Somebody with an expert knowledge of elephants, their breeding, &c., will have to be consulted before these corridors are marked out. If we reserve the wrong places as corridors, what would happen ? Who could get the elephants to move ? "

Senator I. B. Palipane—" Sir, we all agree that the human population is increasing at a very fast pace. The animal population is also increasing ; so the sum-total is briefly this. Due to the increase in population, the land is getting less and less. I therefore submit most respectfully that we should share what we have got in the most equitable manner and decide what space should be given to human beings and what should be left for animals. If there is insufficient space, we may have to migrate to countries where there is more space."

Mudaliyar N. M. Abdul Cassim Marikar—" I am in entire agreement with the mover of the motion on principle, regarding the preservation of wild life. We have heard many speakers, one of them being the Conservator of Forests, who has briefly given us an idea of the position in relation to wild life and human existence. Gentlemen, let us decide first whether wild life should be given preference to human needs. If preference is given to human life and existence, the discussion will be one that will have to wait till a systematic scheme of land development is laid down. Now, as the population of this country is growing, we need land and more land and without land the agricultural prosperity cannot be settled. We cannot think of agricultural advancement without land. We will need land if we hope to increase our food production ; without land it cannot be done or thought of. We cannot imagine increasing our food production without land being made available. I entirely endorse the comments and the observations made by the Conservator of Forests. He has advised us to wait until a systematic development scheme is formulated and then find out whether it is possible to maintain a continuous corridor scheme with a view to safeguarding the wild life of the Island. I do not want to be misunderstood that I am not in favour of the preservation of wild life ; far from it ; but human existence should be considered first. At the pace the population is increasing we cannot think of it. I think we should patiently wait till a systematic method of development of land is undertaken. Paras. 2 and 3 will not arise if we come to the conclusion that before corridors are considered the needs of agriculture should be taken up. When once we come to the conclusion about our agricultural needs we will be in a better position to establish corridors that were referred to in this resolution."

S. A. I. Elapatha Dissawa—" I would like to make a few remarks on the statements made by the Conservator of Forests and the Director of Irrigation. Both of them seem to agree that a planned scheme should be adopted before anything else could come up, but I would like to ask one question. I do not think either of them will disagree to make the present catchment areas our reserves. In any case the catchment areas of the irrigation schemes cannot alter with the population, because our irrigation schemes must go on. If our catchment areas are cleared, automatically our water supply will go down and our schemes will come to an end. Where will our agriculture be ? Primarily, I am asking whether the catchment areas of

our big irrigation schemes cannot be made reserves for wild life. In my opinion I think that this is the safest method of preserving our wild life and at the same time having our Irrigation schemes and our corridors. Take Gal Oya for instance. Before the scheme came into being Gal Oya valley had two springs, which during the dry weather went dry. When they went dry, the elephants strayed away up to Yala and even up to Panamure. For the last thirty or forty years we have had our kraals at Panamure and it is only during the dry season that elephants stray to Panamure in search of food and water. I am glad to say that the Walawe scheme will also come into being in the near future so that these wild animals that were straying for miles and miles in search of food and water will have another place for them. One of my friends asked me how many elephants there are. I cannot say it on authority, but in the Ratnapura district we have just a few herds of animals and 30 to 40 stray ones. They too move on to Panamure in search of food and water during the dry weather. In the Southern Province I might say that in the last four months, during which time I visited Yala about three times and was there at one period for 10 days or so, there is anything up to 100 elephants. These animals are local to Yala, but when they need food and water they may make their way to Gal Oya where there is food and water. If we can at least make the catchment areas of our present irrigation schemes reserves, the proposals made by Major Fonseka and Mr. Ellepola would be considered. The catchment areas which now exist should be made animal reserves."

Chairman—" Thank you. "

Mr. G. B. Portsmouth—" Chairman and Gentlemen, I have heard remarks made by various speakers that the human population is rapidly increasing and that the need for the development of areas for man is also a high priority. From what I have gathered from this discussion, it would appear that it is still possible to put into operation a plan as envisaged in this motion ; but if we are going to wait, more land will be developed and it will become physically impossible to put this scheme into operation. We have to do something almost immediately for the preservation of the animals of this country, or we will not be able to do so. I do not want to put the case of the animals before human beings, but we have all the opportunities of planning. If the human population eventually wants more land for prosperity, they can take it away from the animals and make it available for human beings ; but we can keep it for the animals for the present. "

Chairman—" As most speakers agree that this matter should be submitted to the authorities for them to take such action as they decide, I propose to send this resolution to the Ministry of Lands and Land Development with the amendment that instead of the Settlement Officer being instructed not to settle lands falling within the demarcated areas, the Government be instructed not to alienate the land in question. I do not think the resolution needs further discussion. If we agree we can leave it for Government to decide on what action to take."

REPORTS OF THE SUB-COMMITTEES

" Gentlemen, I understand that no formal memoranda have been submitted by the Conveners of the Sub-Committees, but that most of the Committees have had meetings. Would the secretaries wish to review the position."

Mr. D. V. Ariyanayagam—" We have had meetings regularly on the first Monday of every month and the reports are in the course of preparation."

Chairman—" I think a summary should be prepared by the Sub-Committee for every meeting so that we would know what the Sub-Committees have done."

Mr. D. B. Ellepola—" In the Paddy Advisory Sub-Committee, we have decided to make a complete block-out of the problems and to study each of these under Sub Heads. The reports will therefore come in stage by stage."

Chairman—" There is a report on the Vegetable Sub-Committee in my hands. Would Dr. Mahamooth tell us what the Animal Husbandry Sub-Committee has done ? "

Dr. T. M. Z. Mahamooth—"The Animal Husbandry Sub-Committee has not met so far, but we intend to meet soon."

Mr. A. V. Richards—"Two interim reports on Cacao and Coffee have already been submitted. The Sub-Committee that was elected by the present Board of Agriculture met on January 26, 1956, and considered the cultivation of Citronella and Lemon Grass. An interim report will be submitted as soon as the discussions are completed at the next meeting."

Chairman—"I think the Convener of the Sub-Committee on Agricultural Education is away. I do not think they have yet met."

"We have in the meantime a comprehensive report on vegetables submitted by Mr. L. H. Fernando, the Convener of the Vegetable Sub-Committee. I believe that it is not quite complete. It will be circulated to members shortly to be discussed at the next meeting. I will have a chance to study it myself. I would like on behalf of the Board to congratulate the members of the Sub-Committee for this most useful document. You will realize what hard work has been done by them in preparing it. If the same effort is put in by the other Sub-Committees we would indeed have some valuable information."

Mr. W. M. Cumaraswamy—"Could the Chairman give me any information as to whether the Coconut Rehabilitation Scheme has been finalized? The papers do not really say on what basis the subsidy is being granted. I would like to know whether manure, seedlings and such other items are being subsidized. This difficulty is engaging the attention of the people in the dry areas. Artificial manure cannot be applied for reasons of a long period of rainlessness during which plants have got to be irrigated. I do not know whether this point has been considered by the Rehabilitation Scheme. May I suggest that some kind of information be given?"

Chairman—"I am sorry I cannot give you any information on this because the Commissioner for Coconut Rehabilitation was appointed only recently. Mr. Cooke, could you please give us any information?"

Mr. F. C. Cooke, Director, Coconut Research Institute—"Fertilizers and manure will be subsidized."

Mr. W. M. Cumaraswamy—"There was very recently inaugurated an association consisting of coconut planters in Jaffna. They suggested that I find this out."

Chairman—"Please ask the association to write direct to the Coconut Rehabilitation Officer. This will be the best procedure."

Mr. D. B. Ellepola—"May I, with your permission, place before you the following for purposes of record. Mr. L. H. Fernando, the Convener of the Paddy Sub-Committee and the Vegetable Sub-Committee is going away on 3 or 4 years study leave. I for myself feel very grateful to him for the hard work he put in especially in connection with these Sub-Committees. I want to emphasize our recognition of the very valuable work done by him in addition to his own numerous duties."

Mudaliyar N. M. Abdul Cassim Marikar—"I heartily endorse the sentiments expressed by the previous speaker with regard to the valuable work rendered by the Convener of these Sub-Committees and who will be leaving shortly. I hope this will go on record."

Chairman—"One other matter before we leave. We now have a Cacao Rehabilitation Advisory Committee. If you Gentlemen are interested in its work I will ask Mr. Richards the Secretary to speak on the subject."

Mr. A. V. Richards—"Chairman and Gentlemen, the Cacao Rehabilitation Advisory Committee has considered the question of payment of subsidies and submitted two alternative schemes to Government. They have been accepted with slight amendments. The first scheme recommended by the Committee is the payment of a subsidy of Rs. 450 per acre in 5 instalments each of Rs. 90 for underplanting marginal Rubber in Cacao. That was the amount specified by the Agricultural Minor Products Sub-Committee of the Board. The other is the payment of Rs. 600 per acre to owners of marginal Rubber lands who

remove Rubber or poison it, establish shade such as Dadap, plantains, &c., and plant Cacao after one year. The subsidy of Rs. 600 is payable in 4 instalments each of Rs. 150. All those who applied for permits to replant their Rubber lands in Cacao have been written to and asked to indicate their choice of the two alternatives. In many cases we find that they prefer to keep the Rubber and get some income from it until Cacao is established. The scheme will come into operation this year, and the necessary staff has been appointed to go round and inspect the land which will be planted in Cacao. Only land suitable for Cacao will be given the permits. Government has also agreed that marginal Rubber land, irrespective of elevation, should also be considered for replanting in Cacao if found suitable for the purpose. This scheme would come into operation next year. On account of the large amount of applications and the paucity of planting materials it is not possible to undertake replanting this year of all areas in respect of which permits have been applied for. More areas will be considered next year. Action is however being taken to multiply plant materials. In this connection an expert on Cacao, Mr. D. H. Urquhart, former Director of Agriculture, Gold Coast, and author of a recent book on Cacao, stated that West African Amelanado Cacao should be grown in Ceylon because of its high yield and its inherent tendency to come true to type and produce a bean which can be uniformly cured and is very acceptable to the chocolate manufacturers in England. We have taken action to carry out a survey of estates on which Amelanado Cacao is grown in Ceylon. At the same time action has also been taken to import plant materials from Malaya where it was originally introduced. The Malayan Government has promised to supply 1,000 pods this year, and more next year. We are also taking action to multiply as much as possible."

Chairman—"Any question?"

Mr. S. Pathmanathan—"We had the pleasure of meeting Mr. Urquhart. He was gratified to find out that these areas in his view are the most suitable areas for Cacao, and perhaps some of the best Cacao grown in the world is in Ceylon. Although our plantations are very old our quality of Cacao and potential yields have been very good. I hope members will take this opportunity which Government is offering to replant Cacao on marginal Rubber lands."

The meeting terminated at 4.15 p.m.

N. P. WIJEYERATNE,
Secretary,
Central Board of Agriculture.

Peradeniya, April 7, 1956.

METEOROLOGICAL REPORT

January-March, 1956

SUMMARY

IN JANUARY the weather over the Island was mainly dry. A major part of the rain experienced occurred during the passage of two low pressure waves close to Ceylon. Wet weather due to the first lasted from the 8th to the 12th, with fairly widespread rain which was heavier on the east side. Rainfall due to the other low pressure wave occurred during the last three days of the month and was mainly confined to the western and south-western parts. This rain was considerably heavy in Chilaw, Colombo and Ratnapura Districts on the 29th. The larger monthly totals were of the order of 10 to 20 inches only and occurred in the north-eastern hill-country and in Batticaloa District. Elsewhere, on the east side as well as in the south-western mid-country, the rainfall ranged from 5 to 10 inches. Least rain (totals below 2 inches) occurred in the Northern and North-Western Provinces and in the central parts of the hill-country. The rainfall was considerably below normal in the north-eastern hill-country, where the greater deficits were of the order of 15 inches or so, the greatest being 22.18 inches at Hendon Estate. Elsewhere over the Island too the rainfall was below normal, except in Chilaw District and the northern parts of Colombo District, where there were appreciable excesses on account of the heavy rain during the last three days. Some slight excesses occurred in the Province of Sabaragamuwa too.

The weather continued dry in February too. For the eastern and north-eastern parts of the Island, comprising the Vavuniya District, the North-Central Province, the eastern and north-eastern hill-country and the adjacent mid-country, this was the fifth successive month with considerable deficiency in rainfall. As the period from October to December is the rainiest season for those regions, this deficiency in rainfall resulted in abnormal drought conditions. The total received during the 5 months was less than half the average, and at many stations it was the lowest on record for the last 65 years. Thus, the total at Vavuniya was only 19.36 inches as against an average of 41.60, at Anuradhapura 18.54 inches against 35.43, at Polonnaruwa 22.22 inches against 50.14, at Kandy 17.59 inches against 37.25, and at Nuwara Eliya 16.00 inches against 35.71. The year previous to this when similar conditions were experienced in these regions was 1890/91, but the rainfall that year was greater. During February there were only 4 days on which rainfall to any appreciable extent was experienced—6th, 24th, 25th and 29th. The bigger monthly totals for the month were of the order of 5 to 8 inches only and occurred in the neighbourhood of Batticaloa and scattered in places in the north-eastern hill-country and the south-western mid-country. Elsewhere over the Island the rainfall was below 2 inches, about 30 stations reporting no rain at all. The rainfall was below normal practically throughout the Island, the bigger deficits being of the order of 5 to 6 inches.

The eastern and north-eastern parts of the Island, which experienced abnormal drought conditions during the five months ended February, recorded an appreciable deficit of rainfall during March too, thus completing six successive months of unusually dry weather. At many stations in these regions the total rainfall received during this period was only about half the average. During March the rainfall was below average in the northern and southern parts of the Island too. At the beginning of the month the weather was dry throughout the Island. Rainfall, in the form of afternoon and evening thundershowers, commenced about the 6th and continued till the 25th. It was mainly confined to the south-western parts, but was fairly widespread on some

days, extending northwards up to Vavuniya and eastwards up to the Namunukula Hills. The weather was dry again during the last few days. Heavier rain occurred in the south-western mid-country, where some stations recorded monthly totals ranging from 15 to 25 inches, the highest being 26.31 inches at Yogama Estate (Dehiowita). Rainfall decreased gradually from this region, the monthly totals at the south-western coastal stations, in the south-western hill-country and in North-Western Province ranging from 5 to 10 inches. There was very little rain in the Northern and Eastern Provinces and in the eastern half of North-Central Province, about 30 stations sending in nil returns. The rainfall was generally above normal in the south-western parts and in North-Western Province, the greater excesses occurring in the south-western mid-country. It was below normal elsewhere.

D. T. E. DASSANAYAKE,
Director.

Station	January									February			
	Temperature				Humidity		Rainfall			Temperature			
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Min. Temp.)	Total	Offset	No. of Days	Mean Maximum	Offset	Mean Minimum	Offset
	°	°	°	°	%	%	in.	in.		°	°	°	°
Anuradhapura ..	85·1	+1·8	66·9	—2·3	72	95	2·37	—3·43	12	89·4	+2·3	66·4	—2·9
Badulla	76·6	+0·4	62·9	—0·9	77	91	2·82	—7·50	14	78·4	—0·6	61·8	—1·3
Batticaloa	80·8	—0·7	72·5	—1·0	76	88	8·19	—4·69	16	81·4	—1·5	72·0	—1·7
Colombo	85·7	—0·8	70·4	—1·4	69	90	4·27	+0·31	6	86·1	—1·1	69·8	—2·3
Diyatalawa ..	74·3	+2·5	55·4	—2·3	76	94	2·96	—3·68	13	76·8	+1·9	55·2	—1·6
Galle	84·1	+0·3	72·0	—1·0	74	90	0·64	—3·24	7	84·5	—0·7	72·3	—1·4
Hambantota ..	85·9	+0·9	71·4	—1·3	70	88	2·93	—1·07	7	85·7	—0·2	72·0	—1·0
Jaffna	83·4	+0·4	70·2	—1·9	65	95	1·07	—3·34	5	85·1	—0·5	69·9	—2·4
Kandy	83·2	+1·0	63·2	—1·7	62	86	0·78	—5·96	6	86·3	+0·9	62·4	—1·9
Kankesanturai ..	83·4	—	73·2	—	72	84	0·85	—2·56	4	84·6	—	72·9	—
Kurunegala ..	87·1	+0·6	67·2	+2·7	64	95	1·91	—3·20	4	90·5	+0·5	66·2	—3·4
Mannar	83·9	+0·6	73·3	+0·9	74	88	1·66	—2·18	8	85·6	—0·6	72·1	—1·7
Nuwara Eliya ..	70·2	+2·5	44·4	+2·6	69	85	1·63	—5·33	8	71·4	+1·8	43·9	—1·3
Puttalam	86·7	+1·2	68·4	+1·6	66	90	1·57	—1·86	5	88·2	—0·1	67·8	—2·5
Ratmalana ..	87·3	—	70·3	—	64	87	3·36	—0·79	7	87·8	—	70·1	—
Ratnapura	90·7	+1·4	69·6	+1·5	62	90	5·21	—1·05	7	92·2	+0·6	69·6	—1·7
Talawakele ..	73·6	—	52·0	—	70	87	1·04	—2·83	7	75·7	—0·7	51·3	—3·2
Trincomalee ..	80·9	+0·4	74·8	+0·5	72	76	3·59	—4·62	12	81·8	—0·7	75·4	—0·4

Station	February (contd.)					March								
	Humidity		Rainfall			Temperature				Humidity		Rainfall		
	Day	Night (from Mini. Temp.)	Total	Offset	No. of Days	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Min. Temp.)	Total	Offset	No. of days
	%	%	in.	in.		°	°	°	°	%	%	in.	in.	
Anuradhapura ..	61	95	1·24	—0·48	3	94·8	+3·5	71·4	—0·2	60	95	1·77	—2·38	11
Badulla ..	72	91	0·96	—2·21	7	82·9	+0·5	63·6	—0·7	70	91	4·21	—0·84	13
Batticaloa ..	74	88	4·76	+0·55	7	85·0	—0·4	75·5	+0·5	75	88	1·13	—2·34	11
Colombo ..	70	93	2·25	—0·35	4	86·1	—1·8	73·8	—0·2	76	95	6·32	+1·66	14
Diyatalawa ..	66	91	0·95	—1·42	11	80·3	+2·9	57·2	—1·0	68	88	6·66	+1·77	16
Galle ..	74	88	0·64	—2·65	4	86·5	+0·2	74·1	—1·0	75	90	3·31	—2·00	11
Hambantota ..	71	85	0·03	—1·43	4	87·0	+0·1	74·0	—0·3	75	90	2·14	—1·25	4
Jaffna ..	58	83	0·06	—1·40	1	89·5	+0·8	75·5	—0·4	63	84	0·57	—1·01	2
Kandy ..	55	86	0·30	—2·09	5	88·7	+0·8	66·3	—0·8	59	87	3·20	—2·22	11
Kankesanturai ..	65	81	0·17	—0·91	1	88·7	—	73·9	—	69	93	0	—1·47	0
Kurunegala ..	57	89	0·14	—1·85	2	92·6	+0·0	72·1	+0·0	62	95	9·73	+2·95	12
Mannar ..	67	90	0·29	—1·41	1	90·2	+0·9	75·4	+0·1	71	93	0·92	—0·92	5
Nuwara Eliya ..	66	78	0·47	—1·52	4	72·3	+1·4	46·3	—0·2	67	86	2·53	—1·56	13
Puttalam ..	61	87	1·34	—0·03	3	90·5	+0·6	72·8	—0·1	67	90	6·71	+3·63	12
Ratmalana ..	64	87	3·46	+0·10	5	88·0	—	74·2	—	70	90	8·27	+1·79	15
Ratnapura ..	60	90	3·59	—1·71	7	92·4	+0·3	72·4	—0·1	67	88	12·73	+2·35	16
Talawakele ..	62	81	0·10	—1·87	3	77·1	—	54·1	—	68	87	3·86	—0·76	12
Trincomalee ..	68	75	1·37	—1·28	4	87·4	+1·9	77·2	+0·7	70	84	0·33	—1·97	3